A Video Distribution Amp to build

SILICON CHIP

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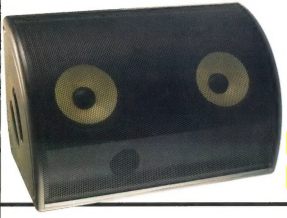

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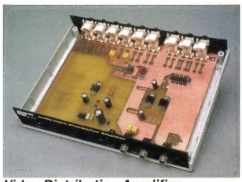

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PUBLISHER'S LETTER

Kyoto protocols could be met

In the campaign for the Federal election to be held on November 10th, Opposition Leader Kim Beazley has committed a future Australian Labor Government to ratifying the Kyoto protocols. If this occurred, Australia would be committed to reducing its greenhouse gas emissions to 8 percent above the levels existing in 1990.

Now whether you believe in the greenhouse effect and consequent global warming or not, Australia should be making a big effort to reduce its greenhouse gas emissions. Apart from any concern about greenhouse gases, Australia really is quite wasteful in its overall use of energy.

Nor do we have to be particularly clever in finding ways to reduce our energy use. In fact, while the USA is commonly thought of as a wasteful nation, in many ways they are much further down the track than Australia in reducing energy use. This is particularly the case with housing design to minimise heat loss and therefore, energy use. If you want instances of this, look at their widespread use of double-glazed and triple-glazed windows, low-E glass, super insulation of walls, roof and floors, air-to-air heat exchangers for central heating and so on.

American householders have been forced down this path mainly because of their bitterly cold winters, far colder than anything most Australians could imagine. Even so, it is likely that many new American homes now use less energy over their winters than most Australian homes do in our comparatively mild winters.

Nor is our energy wastage confined to the domestic scene. In transport and industry we are also very wasteful and there is lots of room for major improvements.

Should we care about energy waste when overall we are doing quite well on the economic front? Well, that's a stupid question really because energy waste costs each and everyone of us quite a lot of money every year.

Overall, I am not sure whether Australia should ratify the Kyoto protocols or not but I am sure that we could get major economic benefits by improving our energy usage. It would not be hard for an incoming government to come up with cost-effective incentives for the housing, manufacturing and transport industries to reduce energy usage.

While we are at it, the Government should act to stop any more coal-burning power stations from being built. If any more thermal power stations need to be built, they should run on natural gas – such power stations have much higher thermal efficiency than coal-fired stations and they produce far less emissions. Gas-fired stations also can be brought on line very quickly and do not have to be left running to provide so-called "spinning reserve". Apart from that, extraction of natural gas is far less environmentally damaging than any form of coal mining.

And finally, it really is about time that the Government made a major push to develop large-scale solar power generation in this country. We have the sun and we have the know-how. Let's push it hard because the future payoffs will be great.

Leo Simpson

MAILBAG

Thanks for prize

I was delighted to win the WaveTek Meterman multimeter with my August Circuit Notebook item. It is a very welcome addition to my test equipment arsenal. My thanks to SILICON CHIP and Fluke Australia for this great prize.

Andrew Partridge,
Kuranda, Qld.

The magic of PMPO

With reference to J. R.'s letter in August's "Ask Silicon Chip", I recently noticed a Ghetto Blaster for sale in a discount store. It boasted 120W PMPO!

Intrigued, I looked at the back of the machine to discover that it was powered by six D cells. My maths says that 120W from 9V DC (no power factor problems) means 13.3333A, not counting the motors or any losses. The loudest noise would have to be the squeals of pain coming from the D cells.

To the manufacturer's credit, the recommendation was to use alkaline cells but . . .

Brian Wilson,
Curtin, ACT.

Sooper Snooper could be used illegally

I am more than just a little disappointed at the lack of legal disclaimer associated with the article on the "Sooper Snooper" in the September 2001 issue. Reference to the Surveillance Devices Act 1999 shows that your article incites, no less than three times, your readers in Victoria to break the law. Nowhere have you made mention that the use of a listening device may be illegal in some states. The three locations I have found are the first line of the introduction, paragraph two and paragraph ten.

Specifically, the Surveillance Devices Act states that a person must not knowingly install, use or maintain a listening device to overhear, record, monitor or listen to a private conversation to which the person is not a party, without the express or implied consent of each party to the conversation.

Normally a professional magazine, this uninhibited disregard for the legislation of this country is unacceptable. I trust that you will issue a legal disclaimer in your next publication.

Ian Stanley-Eyles,
via email.

Comment: readers building the Sooper Snooper project should be aware of the relevant clauses in the above Act. The full text of the Act can be accessed at: http://www.dms.dpc.vic.gov.au/

Electrical fatalities are not caused by homeowners

I'm not sure whether you've published the following information before. I recently completed a TAFE course on electrical inspection and testing (course # 5661F – commonly known as the "tag & test" course) here in Wollongong. This entails a 2-day course, where the basic principles of AC power transmission and terminology are taught, along with basic concepts (voltage, current, resistance, etc) and workplace testing and safety procedures were introduced.

Part of the course is to learn how to use a 'megger' device, in order to perform electrical tests on cables and extension leads. Another part of the course is to actually make (under supervision) a 3-pin extension lead, test it and then 'tag' it as safe. The funny thing is, we were told by TAFE teachers several months ago, that once we had completed the course, we could be either licenced by WorkCover or Fair Trading, so that we could independently test equipment.

When I recently approached both bodies however, I was told that neither of them had ever heard of any such arrangement. The only licences available in NSW are the full electrician's licence, or the 'restricted' (because it's still restricted to only the chosen few?) licence which allows certain people to connect/disconnect fixed wiring, as part of what they normally do (eg, plumbing, etc). It looks like the 'old boys' club strikes again. What's the point of training someone to use a megger and a DVM, and then telling them that they can only use an approved test machine (eg, Safe-T-Check) and more to the point, why teach someone how to make up a 3-pin extension lead, if they're not allowed to do it for a living?

Perhaps another pertinent point is that of manufacturing. There must be literally hundreds of people on factory production lines around Australia, making up leads, power supplies and other high-voltage equipment and accessories, that eventually consumers will use. Just how "qualified" is a factory worker to make, inspect and test such equipment and what TAFE course have they done in order to prove their competency in this area? The issue is why can an unqualified factory hand manufacture equipment, that people with years of training and experience are forbidden to work on – even if it is just a part of their hobby?

As a result of all of this, I believe that people are being trained to do what some electricians regard as their 'dirty work' (tag and test, etc) but those who gain the TAFE competency based 'statement of attainment' will in no way be rewarded with anything that looks like a licence or permit, that will allow them to operate as independent contractors. We were told very strictly in class, that this course does NOT make us into manufacturers or repairers (we probably can't even legally repair the 3-pin cord that we made as a class exercise – what a farce!)

There were several other startling developments that were revealed to the class during my brief time at TAFE. They were:

(1) In 1999, of the 10 electrical fatali-

ties reported to the NSW Department of Fair Trading, eight concerned licenced electrical contractors, who were careless when working on live power installations (FT report B-15, for January 2000) while the other two concerned non-tradespeople who came into contact with damaged or unsafe equipment (an unearthed fridge and a broken light bulb).
(2) The TAFE lecturers, themselves licensed tradespeople, let slip that the whole electrical industry will probably be deregulated over the next three to five years anyway. One of them also mentioned the industry deregulation in New Zealand.
Name supplied but withheld at writer's request.

High current is not problem

50 AMPS, run for the hills, Ma Baker. Peter Raffaelli, what a man! I just loved his letter in the September 2001 issue. Electricians love to tell you that they work with AMPS and that limp-wristed techs work with milli/micro amps. (squeak, squeak). As T. Bradley pointed out in the same issue, working on substations or any other field where high voltages and currents are present doesn't rate a mention when trying to get approval to do some house wiring. For the record, milliamps can kill you just as easily as amps can.

As for Joe Bloggs getting the Active/Neutral wires around the wrong way, this can be easily explained. People are told that their house wiring is AC. This is only partially true. The Active wire has an AC voltage on it while the Neutral is at the same potential as the Earth wire. If, indeed, your house received a true AC then both wires (active/neutral) would reverse polarity periodically. Then there would be no problems as to which side either wire was placed. This is why the consumer can come unstuck, through misleading information.

I do not think those who want change are for an open-slather approach; just one that is fair. Nobody wants people dropping like flies from being electrocuted. If you looked up the statistics, you would probably find that a large proportion were electricians.

Peter mentioned the National Restricted Electrical Licence. This amounts to nothing more than being allowed to connect/disconnect hot water systems. A lot of people, especially electricians think (quite wrongly) that the Licence gives you the right to put in power points. Just don't try it as you will be in for a big shock. And a bigger fine.

Changing laws can be a time-consuming business. It's better and quicker just to add a few clauses to the Restricted Licence. They being;
Clause 1: The holder can move or add power points, light fittings and switches to existing wiring.
Clause 2: Builders of kits or any design that incorporates the inclusion of transformers that need to be connected to mains power can do so.

There needs to be a minimum amount of knowledge held by the person applying for the Licence; having done and passed Electrical Principles 1 and 2. This at least shows knowledge on the subject.

I. Moore,
Port Macquarie, NSW.

DVD picture quality can be very good

I read with some astonishment the letters from Brad Sheargold and John Richardson in the October 2001 issue. My experiences with a Grundig widescreen (CRT) 100Hz set and an inexpensive Toshiba DVD player have been uniformly superb.

Perhaps the Fujitsu plasma display mentioned was set up incorrectly or some experimentation with the DVD player setup menus was needed. I have been delighted with the video (and audio) quality of my reasonably modest setup, viewing 40 or 50 different DVD movies so far. Certainly it has been unnecessary to spend $10,000 on a posh player.

I have also watched DVD movies on a large Philips plasma screen elsewhere and was very impressed. If my available budget had been large enough, I would have bought that screen on the spot.

As for widescreen TV problems, I will agree that the digital TV broadcasts can sometimes change format at frequent intervals but do not find this particularly disturbing as the TV is set to expand the picture to fill the screen. It does this in a nonlinear fashion, with 4:3 pictures expanded most at the left and right edges so that the resultant effect is almost unnoticeable. The thought of returning to VHS fills me with horror, with its far worse picture quality, though passable sound.

I am extremely conscious of picture quality as I regularly enlarge medium format colour negatives to 40 x 50cm and am used to critically assessing the results. It is certainly true that watching a widescreen DVD movie on a 4:3 set is not a fabulous experience. However, use a 16:9 set of even moderate size and the difference is huge.

Perhaps I have been fortunate in my choice of TV, player and DVD movies, but it seems unlikely that I would never have encountered any of the problems mentioned in the above letters if such problems were as common as claimed.

Ross F. Hall,
via email.

Videoscope a timely project

Thanks for the VideoSCope in the October issue; just the project I've been looking for to get my sproutcam (webcam 2 at http://www.woa.com.au) back and operating again. It was a case of forehead slapping as to why I had never thought of that. I even have three old 50mm (1 x 28mm & 2 x 135mm) lens floating with bits of 50mm pipe.

Could I put in a request for a PCM-controlled bicycle lighting system? My particular interest is long distance with recharging from hub generators.

Terry Collins,
via email.

"Mantel" vs "Mantle"

Thank you so much (once again) for providing us with a "real" Australian electronics magazine. It's good to see that Jim Rowe and others have joined your team of authors.

Sorry to be a bit nit-picky, but would you please tell Rodney Champness (in the nicest possible way, after a large thank-you for his articles on Vintage Radio), that the sort of radio he is referring to is spelled "mantel", not "mantle".

Like mantel clocks, they sit on a mantelpiece.

David Pulford,
Forestville, NSW.

Refinement for Videoscope

Thank you for another brilliant project in SILICON CHIP. I am referring to the VideoSCope in the October 2001 issue. I have built it and find new uses for it every day. However, one aspect which could be improved is the camera mounting plate or more specifically, how to fit it into the joiner and get the cable and gland all into position. It is very fiddly and I found I got very frustrated with it until I came up with a brilliant idea.

Simply cut or file a groove in the round mounting plate the shape of the cable from the camera. This will allow the camera to be fitted to the plate, cable to

be fitted to the camera and protruding from the hole in the mounting plate. This then allows the whole assembly to slip into the joiner with the groove allowing the cable to pass, then the gland is fitted and after that the retainer piece is fitted.

The accompanying picture shows the modified plate I used.

Colin Leonelli,
via email.

Watch out for fake power transistors

I repair audio power amplifiers for a living and have had an unusual problem with five amplifiers over a period of the last six months. They either appear to be unrepairable or will bench test OK and then be returned by the owners with the inevitable comment "It's the same fault (blown output transistors)". Because I repair lots of amplifiers, I have a fairly sophisticated test setup which allows me to test them at less than full power to verify operation and to then test them at full power.

Three of the five tested OK on the current-limited supply but when a sine wave test was performed with a full load and full power supply voltage, they almost immediately blew the output devices. The other two performed to spec but were later returned as being faulty. It finally clicked. All of these amplifiers used 2SA1302/2SC3281 transistors in the output stages. One of the amplifiers was a hifi unit rated at 50W per channel; considering that these devices are rated at 250V VCE, Icmax 15A Pd Max 200W, this is a case of overkill.

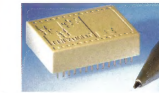
Removing the previously replaced output devices from the amplifiers and carefully inspecting them found the problem. Even though they are marked with the Toshiba brand, they are not Toshiba devices. Using a straight-edge across the mounting surface it is immediately obvious that the mounting base (collector) is concave. When the transistor is mounted to the heatsink, the area where the chip should be is not in contact with the heatsink, hence the failure. But it gets better.

The accompanying photo shows two devices with the epoxy removed. The one on the right is the fake. The problem in all five amplifiers was fixed by importing the genuine Toshiba devices from the USA.

Ian Rumbold,
Sound Developments,
Melbourne, Vic.

Comment: these are the same devices as used in the Ultra-LD amplifier in this month's issue, so readers should be warned. Use genuine transistors with the Toshiba or Motorola trademark.

The Tiger comes to Australia

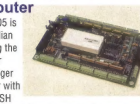


The BASIC, Tiny and Economy Tigers are sold in Australia by JED, with W98/NT software and local single board systems.

Tigers are modules running true compiled multitasking BASIC in a 16/32 bit core, with typically 512K bytes of FLASH (program and data) memory and 32/128/512 K bytes of RAM. The **Tiny Tiger** has four, 10 bit analog ins, lots of digital I/O, two UARTs, SPI, I²C, 1-wire, RTC and has low cost W98/NT compile, debug and download software.

JED makes four Australian boards with up to 64 screw-terminal I/O, more UARTs & LCD/keyboard support. See JED's www site for data.

TIG505 Single Board Computer



The TIG505 is an Australian SBC using the TCN1/4 or TCN4/4 Tiger processor with 512K FLASH and 128/512K RAM. It has 50 I/O lines, 2 RS232/485 ports, SPI, RTC, LCD, 4 ADC, 4 (opt.) DAC, and DataFLASH memory expansion. Various Xilinx FPGAs can add 3x 32bit quad shaft encoder, X10 or counter/timer functions. See www site for data.

$330 PC-PROM Programmer

This programmer plugs into a PC printer port and reads, writes and edits any 28 or 32-pin PROM. Comes with plug-pack, cable and software. **Also available is a multi-PROM UV eraser with timer, and a 32/32 PLCC converter.**

JED Microprocessors Pty Ltd
173 Boronia Rd, Boronia, Victoria, 3155
Ph. 03 9762 3588, Fax 03 9762 5498
www.jedmicro.com.au

Recently Australian speaker designer and manufacturer VAF Research introduced a new high-performance Public Address speaker to its range of highly regarded hifi and home theatre speakers. And they've been run off their feet ever since! We asked Philip Vafiadis, of VAF Research, to explain the philosophy behind the design of the I-201 Public Address Speakers.

Defining The Ideal Public Address Loudspeaker

LOUDSPEAKERS play an important role in a public address system (or for that matter any sound reproduction system) as the final link in the signal processing chain.

They convert electrical energy from the power amplifier into acoustic energy in air that travels as sound waves to the listeners. Regardless of the quality of the preceding signal processing chain, if the loudspeakers are of poor quality or incorrectly connected or operated, the result will be poor quality sound.

Typically, the performance of loudspeakers is orders of magnitude (ie, multiples to the power of 10) ***worse*** than what we would accept from other audio processing devices.

At some time or other, we have all struggled to understand a public speaker in a church or school hall amplified with the typical "column" or horn loaded public address loudspeaker system. In fact, most people have concluded that high-quality vocal reproduction in a reverberant environment is difficult, if not impossible.

So what exactly are the requirements for a public address loudspeaker?

Well, it must reproduce acoustically the electrical input signal at an adequate level to be heard, without introducing distortion or colouration. The loudspeaker must accurately match the 'timbre' of the voice or instrument it is reproducing. The sound should be clear and intelligible for each listener, even though the listeners may be widely dispersed in three dimensions. If used inside an enclosed space, it must do this with the added encumbrance of the superimposed room acoustics.

The loudspeaker should not be prone to feedback or howl-around, when used with open microphones. From a practical point of view, it should be small, light and visually unobtrusive. It should be physically constructed in such a way that it can be installed in optimal positions, both

acoustically and aesthetically. Finally, it must connect and function reliably.

There are many methods of converting electrical energy into acoustical energy (including some esoteric ones) but the overwhelming majority of loudspeakers use electrodynamic transducers constructed with voice coils in permanent magnet fields driving a moving diaphragm. Electrodynamic transducers have so far proven to offer the best balance of performance and ruggedness at an affordable price.

To achieve the performance ideals listed above, the following areas of loudspeaker system performance are important:

- Time Alignment and Source Coincidence,
- Controlled Directivity, and
- Stored Energy.

Time Alignment and Source Coincidence

Currently available electrodynamic transducer technology dictates that a full bandwidth response requires two or more drivers to handle high and low frequency ranges.

Therefore, the acoustic output of a loudspeaker system is the sum of the outputs of its individual drivers, which are in physically different locations on the baffle.

Because of the displacement between drivers, the acoustic transmission path distance from the listener to each driver's acoustic centre will be different for each listening position. Therefore, in-phase arrivals of two driver's outputs can only occur exactly at one point in space for one listener where the path distances are equal (or offset as necessary). Typically, this point will be along the loudspeaker's main axis.

Thus, a typical loudspeaker can only be exactly "time aligned" at one point in space. At all other locations it will be time misaligned! This misalignment causes ripple in the frequency response for about an octave either side of the crossover frequency. Unfortunately, this is typically where the ear is most sensitive, in the region from 1-4kHz!

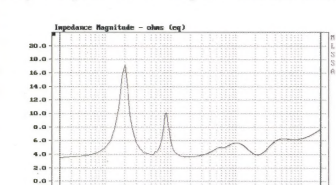
The individual driver outputs from a 2-way horn-loaded system at best can only sum properly in one plane and at worst along only one axis. Above and below the vertical axis, the path distances vary significantly between the horn and bass driver and correct reconstruction of the audio signal can not, and does not, occur. Even side to side, the effective path length through the horn can vary enough to cause ripple in off-axis frequency responses.

In order to prevent the problem of different path lengths to the listener from each driver in a multi-way system, the drivers' effective acoustic centres *must* be coincident. This can be achieved either by coaxial drivers, or by a mirror image array, with appropriate signal processing delays if necessary. Note that either arrangement of drivers in itself does not guarantee coincidence *or* time alignment!

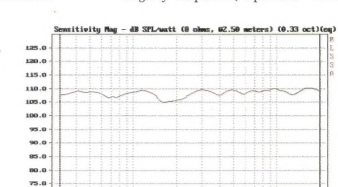
The high-frequency driver in a coaxial design has its terminating acoustic load modulated by the position of the bass driver's cone, which in turn leads to high levels of intermodulation distortion. Unlike coaxial designs, the high-frequency driver in a mirror image array is decoupled from displacement modulation effects caused by the bass drivers and has low levels of intermodulation distortion.

Controlled Directivity

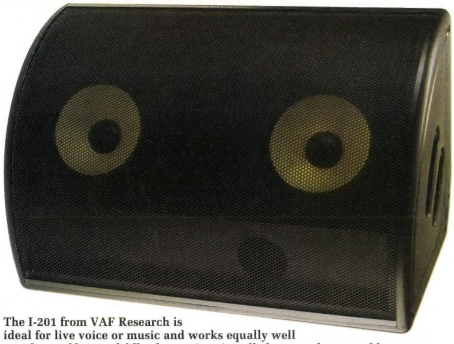
So called "high Q" or Controlled Directivity loudspeaker systems are all the rage today. Unfortunately, there are a number of false premises on which this trend has been based. First is the notion of matching the loudspeaker coverage pattern to audience area. In fact, if we reverse engineer the ideal coverage pattern for a loudspeaker in a typical application using a CAD simulation program, it can be shown that normally a conical or slightly elliptical ("squashed" coni-



I-201 Impedance curve



I-201 Sensitivity (300Hz-20kHz) W/m (on axis/8 ohm reference)



The I-201 from VAF Research is ideal for live voice or music and works equally well as a front-of-house, foldback, monitor, installed, arrayed or portable system.

cal) polar pattern is normally the best fit.

A second false premise is the notion of minimising reflections off nearby walls for improved intelligibility. In fact, reflections in the first 20 milliseconds or so *enhance* intelligibility and reflections from walls much further away are typically attenuated enough by inverse square law so as not to be significant.

A third false premise is the notion of minimising the reverberant energy field in the room, to maximise intelligibility and articulation. In fact, it is generally more significant that the reverberant sound field has even energy against frequency. In other words, articulate, intelligible speech is possible in a highly reverberant room *despite* the long reverberation time.

For musicality *and* intelligibility generally, it is important that a loudspeaker system delivers a smooth power response. Power response is defined as the total acoustic power output in all directions against frequency, as opposed to frequency response, which only considers one point in space. Of course, the frequency response is important too but in *all* directions! Power response can be considered like an average of frequency responses taken in all directions.

A smooth power response will mean that the decaying reverberant sound field in a room will more closely match the direct sound field. This is important to achieve a natural sound quality for both voice and music, and actually makes speech easier to understand.

The problem with horn loaded loudspeaker systems is that by definition they have severe discontinuities in their power responses. In other words, they fail to deliver the promise of clearer, more articulate sound. The bottom line is that a "low Q" loudspeaker system will sound more musical and need less equalisation than a "high Q" system.

Feedback Stability Margin

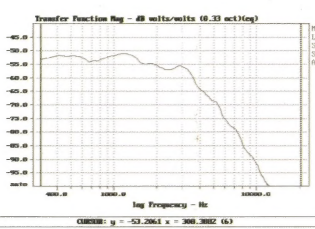
It is a commonly held belief that feedback in a sound system is a result of excessive gain at one frequency and can be controlled by reducing the gain at that frequency. And yes, those two statements are true – but there's more to it than that.

Feedback is always occurring in a public address system with an open microphone, because sound reproduced by the loudspeakers will be picked up by the microphone and reproduced by the loudspeakers and around the loop it goes again.

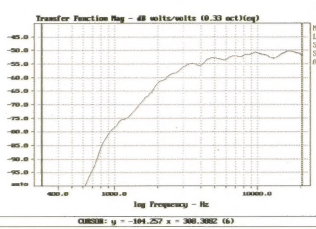
Normally the total gain or amplification around the loop is less than unity, so the system remains stable and useable. Essentially, this is because the rate at which sound energy is being added is less than the rate at which it is naturally decaying.

If, however, the gain around the loop exceeds unity, then the sound level will build up rapidly, causing the squealing known as feedback. Because of the imperfections of typical sound equipment, there will be a small number of frequencies with more gain around the loop than general and these frequencies will be the ones which "take off" when the system goes into instability.

Perhaps surprisingly, these frequencies do not necessarily relate to peaks in the frequency response. The time for



I-201 Woofers with x-over Ckt Out - misaligned)



I-201 Tweeter with x-over Ckt Out misaligned)

SPECIFICATIONS

Frequency Range	45Hz to 25kHz
Frequency Response	65Hz to 20kHz (±2.5dB) with grilles
Power Handling	For amplifiers to 200W RMS
Impedance (nominal)	4W
Sensitivity	95dB (1W @ 1m)
Enclosure type	35-litre, vented
Drivers	2 x 210mm fibreglass cone woofers with 37.5mm aluminium voice coil and synthetic high compliance surround; 1 x 25mm impedance-matched soft dome tweeter with aluminium voice coil. Tweeter protection provided.
Crossover	Displaced pole third order
Crossover Components	2% tolerance air-cored heavy-gauge inductors; close-tolerance metallised polypropylene capacitors.
Crossover Frequency	2700Hz
Connectors	2 x Neutrik Speakon™ 4-pin connectors (in/out).
Enclosure	Arrayable (90° arc) and stackable, 18mm MDF with internal bracing. Finished in textured black. Black perforated steel front grille.
Finish	Matte black. Black perforated steel front grille.
Mounting	Top hat suitable for 35mm poles. (Other options on request).
Dimensions (mm)	640 (h) x 490 (widest point) x 320 (deepest point)
Weight	18 kg

sound to travel from the loudspeaker to the microphone is typically 5-25 milliseconds, which is a lot of cycles at voice frequencies.

In other words, there is plenty of time for the sound energy level to decay during the propagation around the loop – unless a resonant mechanism is at play. Resonances cause energy to linger at specific frequencies, making the system prone to feedback at those frequencies.

Sources of resonance (or energy storage) in loudspeakers include, but are not limited to, misaligned crossovers, cabinet panels, dust caps, diaphragm break-up modes, and cavities including those in the horns of horn-loaded systems. Unless well damped, these resonances will be the feedback break points in the system.

Eliminating or at least severely attenuating system resonances improves the feedback stability margin to near the theoretical maximum. In practice, this provides more than enough gain before feedback for most applications, even in difficult acoustic environments such as churches, provided good quality microphones are used.

Horn-loaded loudspeakers are at a distinct disadvantage in feedback stability margin because of the number of resonant modes supported in a typical horn. Often the assumed gain-before-feedback advantage of controlled directivity is more than traded off because of this.

Introducing the VAF Research I-201

Recognising that loudspeakers are by far the weakest link in the public address audio chain today, VAF Research has used CAD (Computer Aided Design) and CAM (Computer Aided Manufacture) techniques to develop a new high-performance public address loudspeaker system, the I-201.

It is intended for use as a general purpose PA loudspeaker in small to medium-sized performance spaces. It is ideal for churches, hotels, restaurants, function centres and other live performance spaces. The I-201 can be used for live voice or music, foldback monitoring or recorded program reproduction.

Multi-purpose cabinet design

The unique cabinet geometry of the VAF Research I-201 lends itself to almost all applications. The ideal angle for a foldback wedge, the I-201 also sits up closer to a side-wall than a traditional trapezoidal design, minimising aesthetic and sight line problems in critical applications. Two I-201s will provide for 180° coverage from a side-wall position and four I-201s form a perfect circle for all-round coverage in a gymnasium, for example.

Where additional reach is required, I-201s can be stacked vertically and/

Kits without compromise

"Sound quality to die for"
Rolling Stone Magazine

"..A new benchmark in every criteria"
Best Buys Home Theatre

Speaker Kits
without compromise
from $312 pr to $8,863 pr

FreeCall 1800 818882
www.vaf.com.au
vaf@vaf.com.au

VAF RESEARCH

I-201 HIGHLIGHTS

- Affordable, multi-purpose arrayable, stackable cabinet design.
- Works equally well as Front-of-House, Foldback, Monitor, Installed, Arrayed or Portable system.
- Full-bandwidth design for music reproduction with reduced need for subwoofers.
- Breakthrough low stored energy design for high feedback-stability margin in reverberant environments.
- High internal acoustic damping, MDF cabinet construction – not a plastic box!
- Powder-coated, anti-resonant, dent resistant, curved metal grille.
- True acoustic time-aligned point source – no electronic processing required.
- Internal crossover with high-frequency driver protection.
- Flush, concealed carry handle positioned on centre of gravity for easy carrying.
- Recessed metal terminal plate with dual linked Speakon™ style connectors.
- Flush 38mm stand-mount adapter in base of cabinet.
- 25mm dome high-power tweeter with acoustic dispersion control.
- Dual 200mm fibreglass long-throw precision bass drivers.

or the angle between pairs reduced from 90° to as little as 0°.

Full bandwidth audiophile quality

Unlike other small public address loudspeakers, the VAF Research I-201's have been engineered to provide strong usable bass for full-range music reproduction. What's more, the high frequency response extends well past 20kHz in a typical PA loudspeaker fashion!

True point source time alignment

The I-201's Vertical Mirror Image Array with time-aligned drivers behaves as a true point source at all frequencies in all directions. The effective acoustical centre of the two bass drivers always remains at the same point as the effective acoustical centre of the tweeter for waves radiated in any direction. Acoustical reconstruction is accurate regardless of polar direction, giving the I-201 the smoothest total power response possible.

Feedback

The I-201's are an ideal choice for a very reverberant hall, in spite of their "low Q" design. Combined with reasonable condenser microphones, there will be plenty of loop gain available, even for a quiet talker standing behind a lectern.

There are three secrets to this success. First, I-201's are a low stored energy system, much lower than typical PA designs.

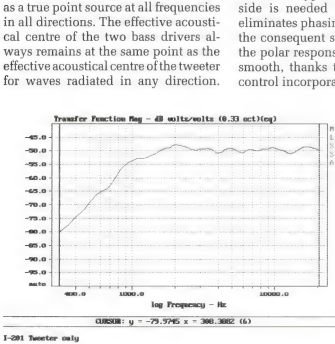
Second, typically only one cabinet a side is needed for coverage, which eliminates phasing between boxes and the consequent side lobes. And third, the polar response of the I-201 is very smooth, thanks to unique diffraction control incorporated into the baffle.

Pricing

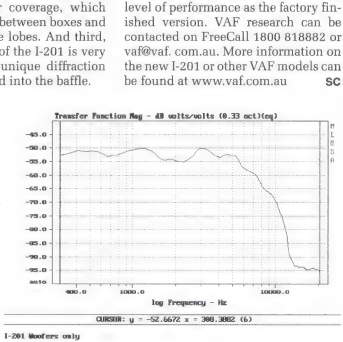
The new VAF I-201 is available only direct from VAF Research, in the following forms:

- Fully assembled and tested: $1100 each.
- Ready to assemble kits where the cabinets are fully built and finished leaving only the final assembly: $940 each.
- Ready to assemble kits without cabinets but including cabinet plans: $599 each.

Insured freight to most of Australia $30 each. If you buy the I-201 as a kit including cabinets, rather than fully assembled, you will get the same high level of performance as the factory finished version. VAF research can be contacted on FreeCall 1800 818882 or vaf@vaf. com.au. More information on the new I-201 or other VAF models can be found at www.vaf.com.au **SC**



I-201 Tweeter only



I-201 Woofers only

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the most **efficient** and **affordable personal analyser charger** from the charger specialist

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How DaimlerChrysler is interfacing the real and the unreal

VIRTUAL REALITIES

Virtual Reality is being used more and more to not only design vehicles but to find the possible pitfalls in manufacture and minimise assembly time and costs. DaimlerChrysler has built a specialist VR facility in Ulm, Germany, where designers and engineers use VR tools to make their work more efficient.

The Virtual Reality Cometence Centre (VRCC) makes VR tools available to developers at their workstations. Depending on the task at hand, employees can select the required degree of immersion in the visual world they wish to enter.

Not only that, they can mix "real" and "virtual" worlds!

State-of-the-art facilities at Ulm include:

- a PC-operated holobench;
- a holostage, a new semi-circular projection which has recently been successfully patented;
- a fully-equipped mixed and augmented reality laboratory.

Holobench – the technology

The holobench, a virtual workbench, comprises a vertical and a horizontal surface onto which projectors display images from behind and from below.

The holobench in Ulm is the first of its kind in the world to be operated using "Infitec technology", which enables stereo-vision through the separate control of the left and right eyes using interference filter technology. The result is a bright, three-dimensional image.

It also uses DLP projectors, which give much greater luminous intensity than do tube projectors.

The computer filters out the ambient light in the room so that the user can work on the holobench in daylight rather than in a dimmed setting.

The VRCC holobench is operated by four PCs, with two more functioning as servers. The latter also carry out collision calculations and determining the position of the user.

Research on the virtual workbench

Long before the first physical model of a newly developed product is tested, designers need to know whether the individual components can be installed easily and cost-effectively. Such construction feasibility studies can now be simulated to a great extent on the holobench.

The engineer puts on a data glove with sensors that measure the move-

ments of his or her hand. A corresponding virtual hand, which can install or remove virtual components, appears on the holobench surface.

Sensors calculate the exact position of the hand in the virtual space. If the electronic hand touches any components, it does not move on any further but a wire-grid hand passes through the part and the point of collision is highlighted in color.

As an example of the many investigations the VRCC has carried out, they examined the removal of the alternator from the Chrysler PT Cruiser. The research revealed that in order to remove the alternator quickly and easily, it was necessary to move another component by just a few centimetres.

The practical aspect in investigations like this one is that the computer "feels" when contact takes place with another component, even in places where the point of contact is obscured by the image of the component. The software makes the components behave "realistically" by simulating their physical and dynamic properties. This means they can even slip along obstacles, altering their position in the space.

In the past, it was only possible to research rigid objects in installation and removal studies. Now, however, DBView — visualisation software developed by DaimlerChrysler — is able to automatically calculate the amount of space required for flexible objects such as cables or tubing.

One example is vehicle seating that has four different axes of movement. Each variant means that a different amount of space is available in the vehicle. The data comes directly from the CATIA construction system onto the holobench surface.

Whereas it was previously only possible to visualise the components, they can now also be altered directly and in real-time. When the collision detection system is in operation, the relevant components are marked – or the virtual seat adjustment does not function to the intended degree.

Even a complicated mechanism, such as a moveable steering column, can be manipulated to estimate its behavior when construction alterations are made. Engineers are particularly interested in how much space the steering column can take up in extreme situations. DBView can make this calculation.

Another typical use of the holobench is the interactive simulation of deep-drawing processes. The settings of the virtual equipment are controlled via a three-dimensional menu, which is operated by a so-called flying mouse.

The sheet metal thickness is represented by different colors before, during and after processing. It is thereby easier to check the stresses acting on the metal sheet during the stamping process.

Semi-circular projection + CAVE = HoloStage

The VRCC has combined the advantages of semi-circular projection with the advantage of the CAVE. This is a room where the floor can also be used as a projection surface but where only one person has good-quality 3D vision.

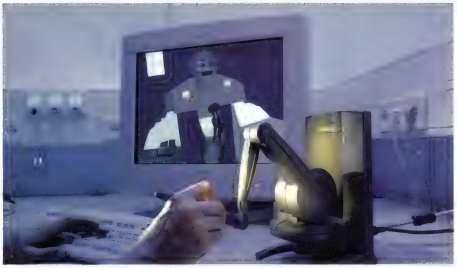
A semi-circular floor was built into the semi-circular projection area. Projection onto the floor is by means of two projectors and mirrors on the ceiling. The result is a stereo-capable holostage, which was recently successfully registered as a patent.

Another feature of the holostage is the tracking system, which allows the observer to see an extremely realistic picture, depending on the angle.

No cables or wires are necessary. Six cameras monitor the position of the user. The boundaries between the horizontal floor and the vertical, semi-circular wall are blurred by the computer, which "softly" masks the edges. The observer sees an edgeless, three-dimensional picture on the holostage.

HoloStage – factory planning

In factory planning it is just as important to consider the movements peo-



ple make, as is the correct positioning of the assembly line or the storage of materials.

Researchers use a virtual model of a person, which moves around independently within the data field of the semi-circular projection. The starting and finishing positions of a particular route are already given but the number of steps taken or the movements made on the way are generated directly by the computer.

Being able to represent or measure routes and distances is only one important factor in factory planning. Another is calculating stresses acting on the spine when an employee has to lift or install a component into a vehicle. These calculations, based on a large amount of medical data, are made on a virtual model to simulate real conditions.

HoloStage – robot teaching

VR technologies serve not only as output media (ie, to represent computer-generated data) but can also be used to input data.

In the case of a robot that installs components or works on a car body in the semi-circular projection area, movements can be planned to the millimetre. To achieve this feat, the robot is taken by the hand, so to speak, by the engineer wearing a data glove. It is then led to the point where a component or tool is to be picked up and then to the point of contact with the vehicle.

Carrying out robot teaching in this way is quicker and easier than entering the complex coordinates step-by-step on a computer.

The information gained from using virtual models of humans for ergonomic studies, teaching robots and calculating likely component collisions on the assembly lines helps planners select the optimal factory layout. It is hardly possible to imagine modern, process-optimised factory planning without VR technologies today.

Mixed reality/augmented reality

The "Mixed-Reality Laboratory" at the VRCC is used to study applications in which it makes sense to combine elements from the real world with images from virtual reality. In this way, it is possible to teach company employees how to undertake complex manufacturing processes long before the launch of a new production series.

The user wears a special head-mounted display fitted with a tiny video camera, which supplies images of what is actually happening. These video images are then exactly combined with a virtual image of the part or component under investigation.

This perfect "fit" between the video images and the computer-generated image of the virtual component is made possible by the fact that all the real components have been given so-called markers.

Markers consist of symbols or numbers on a flat surface, which are registered by the video camera and then transmitted to the computer. They tell the computer the precise angle at which the virtual image has to be positioned.

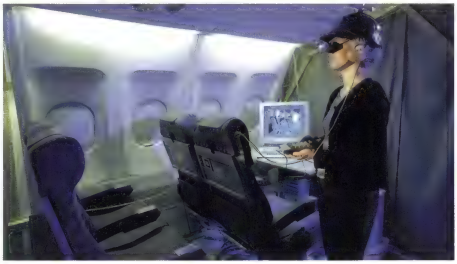
In addition to this combination of images, the user is also provided with further information — in the form of text, graphics or video images — on how to install a component. This might include information on which tool should be used, as well as where to start. It is also conceivable that live images of an instructor could be superimposed.

The new technology also has numerous applications in the fields of maintenance, vehicle diagnostics and service.

For example, a mechanic is faced with a defect. Equipped with a semi-transparent head-mounted display, he or she is provided with the relevant information about the state of the vehicle. To guide the mechanic, an instructor establishes the precise nature of the problem through a natural language dialog. Images, graphics or arrows pointing to specific vehicle components indicate where the problem might lie.

Even in a normal workshop situation, the use of mixed and augmented reality could help combine the usual toing-and-froing between reading the manual and actually working on the vehicle into a single activity and, as such, help cut repair times.

Such a system would be particularly



attractive in remote regions where the workshop may not have a lot of experience on a particular make or model. In such a case, the mechanic or even the driver would be able to obtain direct advice on the nature of the problem.

Mobile VR

To increase the flexibility of maintenance and inspection routines for large fleets of vehicles, VR technology is also set to become increasingly mobile.

A portable video unit strapped to an engineer's belt will be able to transmit images to the computer. Once there, virtual reality images will be integrated and then sent back to the engineer's head-mounted display.

In such a context, the navigation aids — including hints about the source of the problem or tips on how it could be remedied — are once again set to play a major role.

Text information could be superimposed on the images at the appropriate point. Such procedures are likely to result in substantial time savings as well a considerable improvement in quality.

On the one hand, there will no longer be any need to consult technical manuals and on the other, the quality of the work can be checked as it occurs.

Cockpit ergonomics

Although virtual reality can be seen, it cannot be touched or felt. In certain situations, it makes sense to use relatively simple elements in order to create real mock-ups containing all the basic physical components that the user needs to establish a tactile contact with reality.

As soon as it is possible to harmonise the virtual and the real worlds in this way, the user is able not only to see objects but also to "grasp" them – ie, touch and manipulate them. As a result, immersion in the world of virtual reality is made all the more realistic.

Another task at the VRCC is to examine various vehicle cockpit designs from an ergonomic point of view. This is also an example of what is known as collaborative rapid prototyping. Here, the designer and user work hand in hand. The user sits in a wooden cockpit mock-up, containing instruments positioned according to the designer's specifications (who sits close by).

Via a head-mounted display, the user is supplied with images of both the planned cockpit and the road or landscape through which the vehicle is virtually travelling – similar to an aircraft simulator. At the same time, the user can also try out the various arrangements of cockpit instrumentation and displays. With the aid of a data glove, the controls can be moved around or reformed into a different shape.

The wooden surface of the cockpit mock-up provides the user with the necessary tactile sensations. The designer is also able to make immediate changes to the cockpit layout during the testing process. As a result, optimal cockpit ergonomics can be achieved more quickly and efficiently.

Flow visualisation

CAD models are made up of an agglomeration of surfaces. However, the process of vehicle design also makes substantial use of aerodynamic flow data and the flow of air inside the vehicle cockpit.

As a rule, flow data is three-dimensional. Here, the complex challenge facing the VRCC researchers was to combine flow data with surface data in one single representation. The idea was to be able to see the effect of various flow patterns, the data for which had been processed in advance by mainframe computers working in overnight shifts.

This visualised flow data is mixed with "real" images superimposed via video as well as VR data relating to the vehicle interior. In this way, various design alternatives can be tested. This might involve the impact that the size and shape of headrests have on the supply of fresh air to rear-seat passengers or the effect that the shape and settings of the air vents have on temperature control in the vehicle.

VR meetings

If VR truly is the intuitive, fully immersive man-machine interface of the future, then it certainly makes sense to extend its scope beyond the current dialog between engineer and computer. In the future, the aim is to use VR in a group context.

All the information relevant to product development must be made available over and beyond system and even company boundaries.

Indeed, such availability must function along the entire length of the chain. In this way, virtual reality could well help bring the twin processes of product planning and product development together even more.

For a graphic example as to what the VRCC researchers have in mind for this exciting new technology, consider the following scenario:

Designers and engineers seated around a conference table are discussing the latest version of a component under development. Each person is wearing a special head-mounted display. In the middle of the conference table is a turntable marked with a range of symbols.

Each participant sees a virtual image of the component from exactly the same perspective as he or she would were it a real visual experience. The 3D model can therefore be fully visualised, with participants able to discuss the latest stage of component development.

Participants do not even need to be in the same room, or even the same country. **SC**

Acknowledgement: Text and photos courtesy of DaimlerChrysler.

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Easily concealed and portable, this is cutting edge miniaturised surveillance technology. The CMOS video camera and 2.4GHz transmitter send full motion crisp colour video images to the receiver up to 100 metres away. Provides up to 12 hours viewing with 4 x 'AA' batteries or connect to mains power for sustained on-site applications. Plugs into any video device, (VCR, TV, monitor). Kit includes camera/transmitter, AV cable, receiver, battery pack for AA batteries, 9V battery connection, power adaptor and full instructions.

Camera specifications:

Operating power: 5-12V DC
Size: 18 x 34 x 20mm
Antenna: Omni-directional
Weight: 20g
Pixels: 365k (PAL)
L 5847

$599

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SpyCam Color CMOS Camera

Features clear quality colour image and easy plug and play installation.
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L 5843

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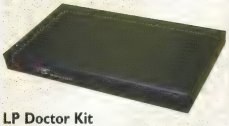

LP Doctor Kit

Start enjoying your records again by playing them through the LP Doctor! The LP Doctor can be teamed with any turntable having a magnetic cartridge so you can listen to your LPs without clicks and pops, or you can feed its signal into a PC sound card for processing and dubbing to CD. Kit supplied with PCB, all components and hardware, pre-punched case, pre-punched, silk-screened front panel, and detailed instructions.

K 5425

$194 SILICON CHIP Jan '01

AVAILABLE POWER HOUSE AND direct link ONLY

Stereo FM Minimitter Kit

Want to listen to your own selection of music through your personal stereo FM radio? Using the FM MiniMitter, you can broadcast from your CD player or from any other source so it can be picked up within a 35 metre radius. Operates from 3 Volts. Uses 2 x AA batteries (not supplied) or a 6 Volt DC plugpack. Supplied with all components, hardware, case, and pre-punched, screened front panel.

K 5007

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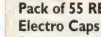

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Part 1: By GREG SWAIN & JOHN CLARKE

THE NEW ULTRA-LD Stereo Amplifier incorporates a preamplifier stage, LED bargraph power meters, fan-forced cooling, gold-plated heavy-duty speaker terminals and a host of internal engineering features that make it easy to build. The external finish and presentation is to a professional standard. This is an amplifier that you will be proud to say, "I built this one myself!"

If you could buy the equivalent of this amplifier from one of the big name brands you would have to pay lots more dollars and even then you wouldn't get the extremely low distortion and noise, very high damping factor and so on.

Oh, and just a word about overall performance – these days there are lots of Dolby surround sound amplifiers and surround systems which are available at relatively low prices and some have quite high power outputs, up to 100W per channel from five channels. Are these comparable to the Ultra-LD?

Let's just put it nicely. For home theatre they are great value but most are not hifi. The Ultra-LD is a purist's hifi amplifier. It's an amplifier for audiophiles; it has no tone controls, no loudness control, no balance control and no switching for multiple speaker systems, all of which can add to distortion and noise.

By the way, we're not alone in adopting this purist concept. Take a look at some of the really expensive "audiophile" amplifiers. Many don't include tone controls or balance controls, or any other unnecessary features. Instead, the aim is to offer the best possible performance for your dollar and that's what we've done with this unit.

It also makes the amplifier delightfully easy to operate – you just switch it on, select the signal source and adjust the volume control to your liking.

Design concept

The original version of this amplifier was published in the March, May & August 2000 issues of SILICON CHIP. To save kit buyers a lot of money, we presented that version in standard PC tower case. This had the virtues of low cost, plenty of internal space for all the modules, different levels for the power supply and amplifier modules, and even inbuilt shielding for signal wires. All told, it was an effective although bulky package.

So why are we now presenting this conventional rack-mounting version? There are several reasons but perhaps the main one is that many readers just did not like the amplifier-in-a-PC-case concept. They reckoned it was ugly, too bulky and pushed the recycling angle too far. Furthermore, the styling clashed with their existing hifi equipment.

Still, we were not keen to revisit the Ultra-LD amplifier concept until Altronics recently indicated that they were seriously interested in producing a rack-mounting version. They weren't so much interested in the

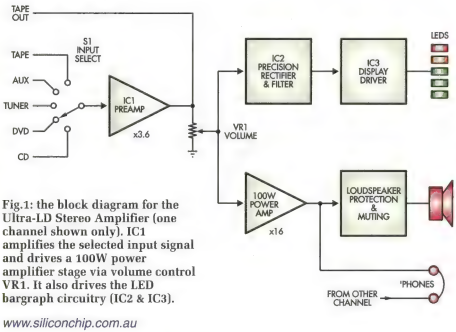


Fig.1: the block diagram for the Ultra-LD Stereo Amplifier (one channel shown only). IC1 amplifies the selected input signal and drives a 100W power amplifier stage via volume control VR1. It also drives the LED bargraph circuitry (IC2 & IC3).

project as a kit but more as an addition to their existing professional equipment. And since it was to be a "professional amplifier" it would need to be substantially redesigned to meet new criteria.

In essence, the new version of the amplifier would have to be easier to assemble. That meant that all soldered wire connections to the PC boards would have to go. Instead, all connections were to be made via crimped "quick connects" and board-mounted spade lugs. In addition, Altronics wanted LED bargraphs to match the styling of other amplifiers in their range and wanted us to adapt the design to a custom-made rack chassis which features an integral tunnel heatsink with fan cooling, slotted front panel and so on.

All of that meant that we had to redesign the PC boards for the amplifier modules and the loudspeaker muting and protection module, as well as design a PC board for the power supply. In addition, we have incorporated a very low distortion preamplifier based on the Philips 5534 op amp and this incorporates the LED bargraph display circuitry. So there is a new board for the preamplifier, plus another board for the stereo RCA socket pairs on the back panel.

The RCA input board and the preamplifier board are connected together using a flat 26-way ribbon cable fitted with header sockets at either end. This eliminates messy wiring to the source switch – you just plug the header sockets at each end of the cable into the matching pin headers on the PC boards and the job is done.

All told then, this version of the Ultra-LD has had to be completely re-engineered to suit the rack case and it is now a lot easier to assemble.

Even so, this is not a project for anyone new to electronics. Apart from having six PC boards to assemble, there is a lot of wiring to run in the chassis. We expect that the average constructor, working carefully, will take around 50-60 hours to build and test it completely. The result will be an amplifier that you can be proud of and one which will deliver superb sound quality for many years to come.

Operating features

As already noted, the Ultra-LD is a very simple amplifier. On the front panel, it has just two knobs, one for the input selector and the other for the volume control. Apart from the On/Off rocker switch, the only other features are the LED bargraphs for both channels and the headphone socket. Plugging in your headphones mutes the speakers via the relays on the muting and protection board.

As well as being pretty, the LED bargraphs in this amplifier do serve a useful purpose. They display a signal range of 30dB so that as each extra LED lights, it indicates a signal increase of 3dB. When the orange 0dB LED lights, the amplifier is on the verge of clipping and so if the topmost red +3dB LED lights, you know the amplifier is clipping and the volume control should be reduced to give the best sound quality and also to protect your speakers against possible damage.

On the rear panel, there are six pairs of RCA sockets, to cater for five stereo inputs (CD, DVD, tuner, etc) and a tape monitor output. The heavy-duty gold-plated loudspeaker terminals can accept the heaviest speaker cables available and while they may look a bit over the top, they are essential in keeping the distortion as low as possible.

As in all high-power amplifiers, ventilation and cooling are important. This is achieved using a fan-cooled internal tunnel heatsink for the output transistors. Air flows in through slots in the base of the case and is blown out through slots in the sides – these must be kept clear.

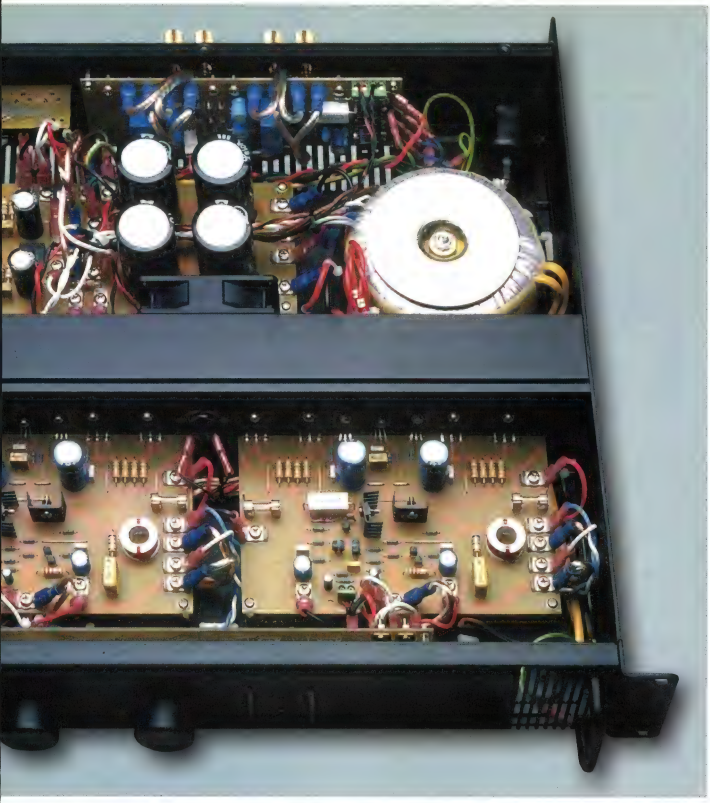
By the way, the fan only kicks in for heatsink temperatures above 60°C, so most of the time it will not be operating, keeping noise to an absolute minimum. After all, there's not much point in having only the smallest whisper of residual noise from the speakers if the fan is noisy.

Block diagram

Let's take a look now at the block diagram of the new stereo amplifier – see Fig.1. To keep things simple, this shows only one channel – the other channel is identical.

S1 is a 5-position rotary switch and this selects the audio input signal – either CD, DVD, Tuner, Auxiliary or Tape. From there, the signal is fed to a non-inverting op amp stage (IC1) which operates with a gain of 3.6. Its output is fed to the Tape Out socket via a stopper resistor and is also fed to volume control VR1.

The output from the volume control has two signal paths. First, the signal on the wiper is fed to a power amplifier which operates with a gain of 16. This then drives the loudspeaker via a loudspeaker protection/muting circuit. It is also fed directly to one



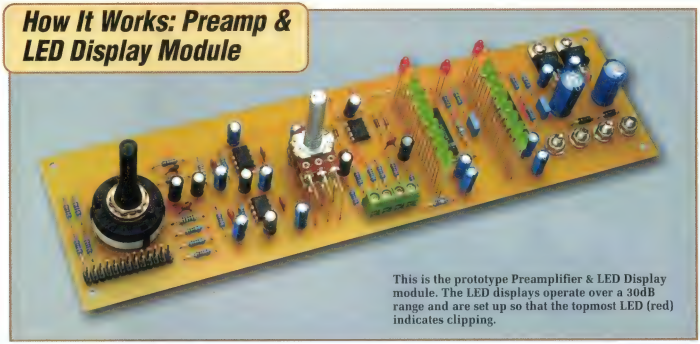
side of the headphones socket.

Second, the signal from VR1 is also fed to IC2 which is a precision half-wave rectifier. It's output is filtered and then fed to a display driver circuit based on IC3. IC3 in turn drives a 10-LED bargraph display. This display operates over a 30dB range and is set up so that the top LED in the bargraph indicates signal clipping.

OK, so much for the basics. We'll now look at each of the main circuit modules and describe its operation in some detail.

Above: the Preamplifier & LED Display module mounts vertically on the front panel while behind it are the two Power Amplifier modules, attached to a large tunnel heatsink. On the other side of the heatsink are the Power Supply module, the Loudspeaker Protector & Fan Controller module (mounted on the rear panel), and an RCA input-socket module (mounted upside down at top, left).

How It Works: Preamp & LED Display Module



This is the prototype Preamplifier & LED Display module. The LED displays operate over a 30dB range and are set up so that the topmost LED (red) indicates clipping.

FIG.2 SHOWS the circuit for the Preamplifier & LED Display module. For the sake of simplicity, only one channel is shown – the other channel is identical.

The preamplifier section uses a single 5534 low-noise op amp (IC1). As shown on Fig.2, the incoming audio source signals (CD, DVD, Tuner, Auxiliary & Tape) are selected by rotary switch S1 and fed to pin 3 of IC1 via a 150Ω "stopper" resistor and a 10µF bipolar capacitor. Note that the CD input is attenuated by feeding it through a voltage divider before it is fed to S1, so that it more or less matches the perceived levels from other sources.

The 150Ω stopper resistor and the 10pF capacitor together form a low-pass filter to eliminate RF interference. Additional RF suppression is provided by a ferrite bead which is slipped over one of the leads of the 150Ω resistor. The 100kΩ resistor on pin 3 of IC1 sets the input impedance and also sets the input bias current for the op amp.

IC1 is wired as a non-inverting amplifier and operates with a gain of 3.6, as set by the 4.7kΩ and 1.8kΩ feedback resistors (ie, Gain = 1 + 4.7/1.8 = 3.6). The 10pF compensation capacitor between pins 5 & 8 ensures stability, while the 390pF feedback capacitor rolls off the response above 100kHz.

IC1's output appears at pin 6 and is fed to volume control VR1 via a 10µF capacitor and 100Ω stopper resistor. In addition, the pin 6 output is fed to the TAPE OUT sockets via a 10µF bipolar capacitor and another stopper resistor (150Ω). The stopper resistors prevent instability by decoupling the output of IC1 from the capacitive effects of long cables.

Following the volume control, the audio signal is fed directly to the corresponding power amplifier. It's also fed to pin 2 of IC2 (TL072) via a 220kΩ resistor and 0.22µF capacitor.

LED display circuit

IC2, D3 & D4 together form a precision half-wave rectifier. It works like this: when the input signal swings negative, pin 1 of IC2 goes high and forward biases D3. As a result, the op amp operates with a gain of -1.5 as set by the ratio of the 330kΩ feedback resistor to the 220kΩ input resistor.

Conversely, when the input swings positive, pin 1 goes low. D4 is now forward biased and clamps pin 1 to 0.6V (ie, one diode drop) above ground. This effectively disables IC2.

As a result, IC2 half-wave rectifies and inverts the negative portion of the audio signal applied to its pin 2. This half-wave rectified signal is then filtered using a 680kΩ resistor and .01µF capacitor and applied to pin 5 of IC3.

IC3 is an LM3915 display driver. As wired here, it operates here in bargraph mode (pin 9 tied high) and drives the 10 LEDs in 3dB steps. The 1.2kΩ resistor between pins 7 & 8 sets the display brightness, while the full-scale reading is set to 1.25V by connecting pin 8 to ground.

This display circuit operates with a 30dB range and the gain of the precision rectifier is set so that the last LED (+3dB) lights at the point of clipping. Inevitably, this leads to some compromises in the display, since most of the action takes place over the second half of the volume control.

At low-to-moderate listening levels, only the bottom two or three LEDs will flash on and off according to the signal peaks. However, that's the way it has to be if you want the last LED to accurately indicate clipping.

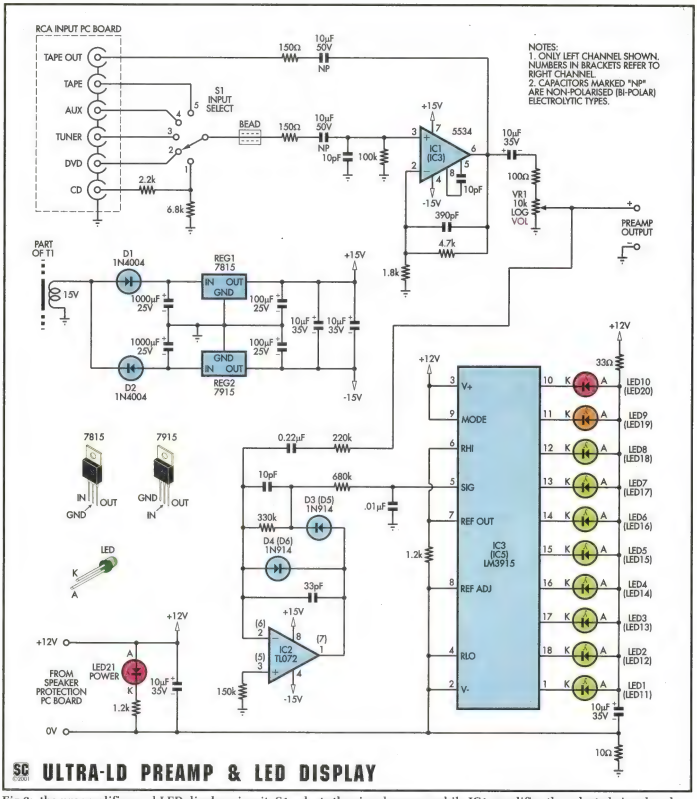
Alternatively, by increasing the gain of the precision rectifier (IC2), we could get more LEDs lighting up at "normal" listening levels. However, the last LED in the bargraph would then come on before the onset of clipping, so the display wouldn't mean much – it would just look pretty.

Power supply

The preamplifier and precision rectifier circuits (IC1 & IC2) are powered from ±15V DC supply rails.

As shown on Fig.2, half-wave rectifiers D1 & D2 are fed with 15V AC from the power transformer to derive unregulated supply rails of about ±20V DC. These rails are then filtered using 1000µF electrolytic capacitors and fed to 3-terminal regulators REG1 and REG2 to obtain the +15V DC and -15V DC rails respectively.

Two 100µF 25VW capacitors are



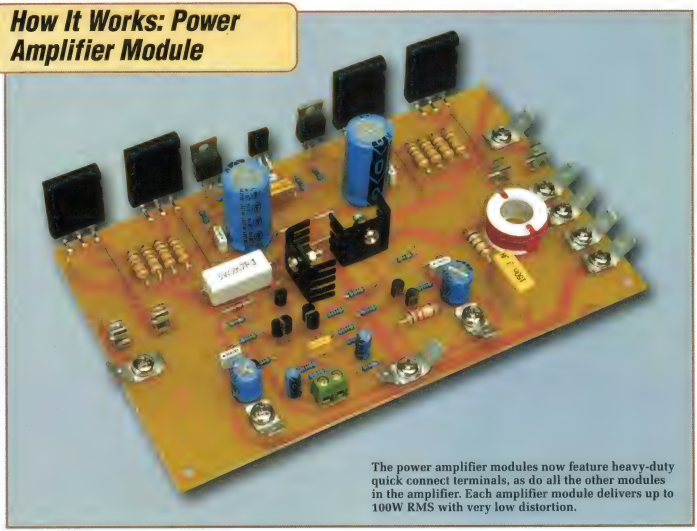
ULTRA-LD PREAMP & LED DISPLAY

Fig.2: the preamplifier and LED display circuit. S1 selects the signal source, while IC1 amplifies the selected signal and feeds volume control VR1. The signal then goes direct to the corresponding power amplifier stage. It also goes to precision half-wave rectifier IC2 which in turn drives an LM3915 LED display driver (IC3).

used to filter the outputs of REG1 & REG2. In addition, two 10µF 35VW capacitors are connected between the +15V and -15V rails. These two capacitors provide additional supply line filtering and are installed close to the supply pins of IC1 and IC2.

IC3 is powered from a 12V rail derived from the Loudspeaker Protector & Fan Controller board (see Fig.5). Note that the LM3915 display circuitry is earthed via a 10Ω resistor, as is the Loudspeaker Protector circuit. This is a precaution to stop induced hum currents flowing in the earth path.

How It Works: Power Amplifier Module



The power amplifier modules now feature heavy-duty quick connect terminals, as do all the other modules in the amplifier. Each amplifier module delivers up to 100W RMS with very low distortion.

FIG.3 SHOWS the circuit for the two power amplifier modules. It's virtually identical to the "Ultra-LD 100W Amplifier" published in the March 2000 issue of SILICON CHIP.

The input signal is coupled via a 2.2µF capacitor and 1kΩ resistor to the base of Q1 which together with Q2 makes up a differential pair. Q3 & Q4 act as a constant current tail to set the current through Q1 & Q2 and this makes the amplifier insensitive to variations in the power supply rails.

The collector loads of Q1 & Q2 are provided by current mirror transistors Q5 & Q6. Commonly used in operational amplifier ICs, current mirrors provide increased gain and improved linearity in differential amplifier stages.

In a conventional direct-coupled amplifier, the signal from the collector of Q1 would be fed directly to the base of the following class-A driver stage transistor (Q8). In our circuit though, the signal from Q1's collector is fed to the base of Q7 which forms a cascode stage with Q8. Q9 provides a constant current load to Q8.

Q4 does double-duty, providing the base voltage reference for constant current sources Q3 & Q9. A 3.3V zener diode, ZD1, provides the reference bias to the base of Q8. In effect, Q8 acts like an emitter follower and applies a constant voltage (+2.7V) to the collector of Q7 and this improves its linearity. The output signal from the cascode stage appears at Q8's collector.

Note the 100pF capacitor between Q8's collector and Q7's base. This rolls off the open-loop gain of the amplifier to ensure a good margin of stability.

The output signal from the Q7-Q8 cascode stage is direct-coupled to the output stage. This comprises driver transistors Q11 & Q12 and the four output transistors, Q13-Q16.

Actually, it may look as though Q9's collector drives Q11 and that Q8 drives Q12 but in reality Q8 drives both; the signals to the bases of Q11 and Q12 are identical, apart from the DC voltage offset provided by Q10.

Vbe multiplier

Q10 is a "Vbe multiplier". It can be thought of as a temperature-compensated floating voltage source of about 1V. Q10 "multiplies" the voltage between its base and emitter, as set by trimpot VR1, by the ratio of the total resistance between its collector and emitter (330Ω + 390Ω + VR1) to the resistance between its base and emitter (390Ω + VR1).

In a typical setting, if VR1 is 100Ω (note: VR1 is wired as a variable resistor), the voltage between collector and emitter will be:

Vce = Vbe x 820/490
= (0.6 x 820)/490 = 1.004V

In practice, VR1 is adjusted not to produce a particular voltage across Q10 but to set the quiescent current through the output stage transistors.

Because Q10 is mounted on the same heatsink as the driver and out-

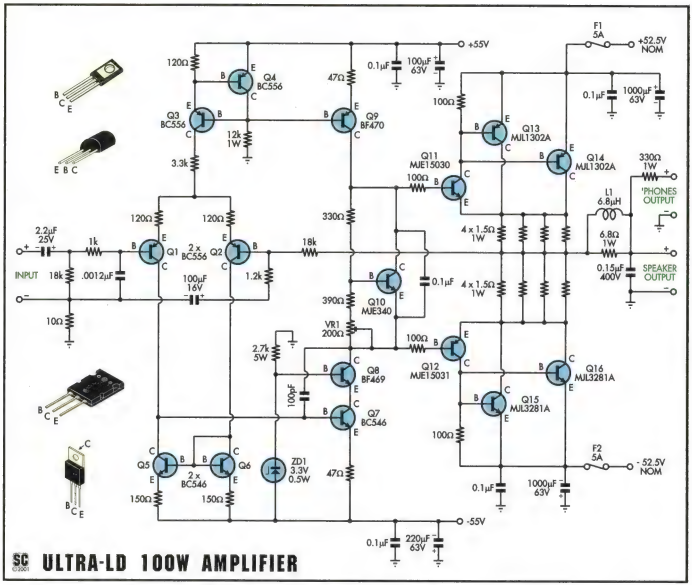


Fig.3: the power amplifier circuit uses differential input pair Q1 & Q2 to drive cascode pair Q7 & Q8. This stage in turn feeds driver stages Q11 & Q12 which then drive the output stages (Q13 & Q14 and Q15 & Q16).

put transistors, its temperature is much the same as the output devices. This means that its base-emitter voltage drops as the temperature of the output devices rises and so it throttles back the quiescent current if the devices become very hot and vice versa.

Driver & output stages

Q11 & Q12 are the driver stages and they, like the output transistors, operate in class-AB mode (ie, class B with a small quiescent current). Note the 100Ω resistors connected in series with the bases of these transistors. These act as "stoppers" and they reduce any tendency for the output stages to oscillate supersonically.

The output stages are connected as compound current feedback (CFB) transistors. This configuration acts like a very linear power transistor but with only one base-emitter junction rather than two as in a Darlington-connected power transistor.

In this circuit, two paralleled power transistors, Q13 & Q14, are connected to NPN driver transistor Q11, while power transistors Q15 & Q16 are connected to PNP driver transistor Q12. The four paralleled 1.5Ω emitter resistors for each CFB transistor pair are there to help to stabilise the quiescent current. They also slightly improve the frequency response of the output stage by adding local current feedback.

Note, however, that there is no intrinsic means in the circuit for ensuring even current sharing between Q13 & Q14 and between Q15 & Q16. What current sharing there is will depend on the inherent matching (or lack of it) between the transistors.

By the way, we did try the effect of small emitter resistors for each of the power transistors but these had the effect of worsening the distortion performance – so we left them out. Note that the current and power ratings of the output transistors are such that even if the current sharing is quite poor, it won't cause problems.

Feedback

Negative feedback is applied from the output stage to the base of Q2 via an 18kΩ resistor. The amount of feedback – and therefore the gain – is set by the ratio of this 18kΩ resistor to the 1.2kΩ resistor at the base of Q2. This

gives a gain of 16 (ie, for a non-inverting amplifier, gain = 1 + 18kΩ/1.2kΩ).

This means that an input signal of close to 1.8V RMS is required for full power.

The low frequency rolloff of the amplifier is partly set by the ratio of the 1.2kΩ feedback resistor to the impedance of the associated 100µF capacitor. This has a -3dB point of about 1.3Hz. The 2.2µF input capacitor and 18kΩ base bias resistor feeding Q1 have a more important effect, with a -3dB point at about 4Hz. The two time-constants combined give an overall rolloff of -3dB at about 5Hz.

At the high frequency end, the .0012µF capacitor and the 1kΩ resistor feeding the base of Q1 form a low pass filter which rolls off frequencies above 130kHz (-3dB).

An output RLC filter comprising a 6.8µH choke, a 6.8Ω resistor and a 0.15µF capacitor couples the output signal of the amplifier to the loudspeaker (via the relay contacts in the Loudspeaker Protector). It isolates the amplifier from any large capacitive reactances in the load and thus ensures stability. It also helps attenuate EMI (electromagnetic interference) signals picked up by the loudspeaker leads and stops them being fed back to the early stages of the amplifier where they could cause RF breakthrough.

The low-pass filter at the input is also there to prevent RF signal breakthrough.

Finally, the output of the amplifier is attenuated using a 330Ω 1W resistor and fed to the headphone socket. The loudspeakers are automatically switched off when the headphones are plugged in, by using the headphone switch to disconnect the drive to the relay driver transistors on the Loudspeaker Protector & Fan Controller module – see Fig.5.

How It Works: Power Supply Module

This easy-to-assemble module provides the ±52.5V and ±55V rails to the power amplifiers. The power transformer leads plug straight into the quick connect terminals on this board.

THE POWER SUPPLY is based on a 300VA toroidal transformer that's been specially sourced for this amplifier by Altronics. This transformer has six windings: 2 x 35V; 2 x 50V; and 2 x 15V.

Fig.4 shows the circuit of the power supply for the amplifier modules. There are two sets of supply rails: ±52.5V (nominal) and fully-regulated ±55V. The unregulated ±52.5V rails feed the class-AB output stages and nothing else.

The fully-regulated ±55V rails feed the input stages and the class-A driver stages of the amplifier. So why have we used these regulated supply rails when just about every commercial domestic stereo amplifier uses unregulated supply rails for the whole power amplifier circuit?

The reasons are twofold. First, the fully-regulated supply improves the separation between channels. Second, with a class-AB amplifier such as this, the very high asymmetrical signal currents flowing in each half of the output stage cause a distorted signal voltage to be superimposed on the supply rails. By using a fully regulated supply, we avoid the possibility of these signals being fed back into the input stages.

Circuit details

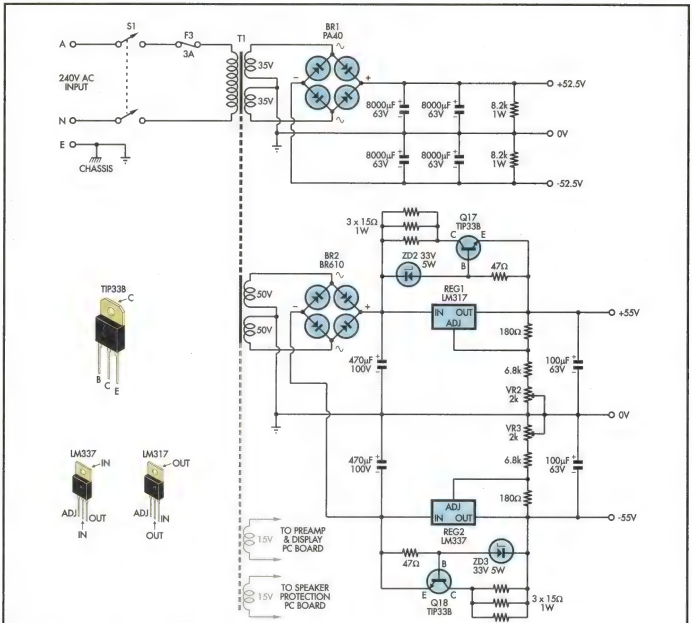
The power supply circuit for the amplifier modules can be split into two parts. First, the two 35V windings are connected together and drive bridge rectifier BR1. This then feeds four 8000µF 63VW electrolytic capacitors to provide unregulated supply rails of around ±52.5V (at no signal) to power the output stages of the amplifier.

The two 8.2kΩ 1W resistors are there to discharge the filter capacitors when the amplifier is switched off.

The two 50V windings are also connected together (to give 100V AC centre-tapped) and these drive bridge rectifier BR2 and two 470µF capacitors to derive unregulated supplies of about ±71V. These rails are then fed to positive and negative 3-terminal regulators REG1 & REG2 to derive the ±55V rails.

It's not what it seems

At first sight, this may appear like a conventional 3-terminal regulator plus booster transistor arrangement, with the power transistor being slaved to the regulator. But that's not how this circuit works.



SC ULTRA-LD POWER SUPPLY

Fig.4: the power supply module produces ±52.5V (nominal) rails for the class-AB output stages of the power amplifiers, plus regulated ±55V rails for the input and class-A driver stages.

Looking at the positive regulator for the moment, REG1 in fact carries all the current, which is only around 40mA, so there is no need for a booster transistor. However, the 3-terminal regulator cannot do the whole job. That's because its input voltage is about 71V and when the power is first applied, this would appear directly across the regulator, causing it to blow (its maximum input-output differential is only 40V).

This is where power transistor Q1 comes into play. When the voltage across REG1 exceeds 33V, zener diode ZD2 is biased on via the associated 47Ω resistor. This causes Q17 to turn on and this limits the voltage across REG1 to around 35V or so.

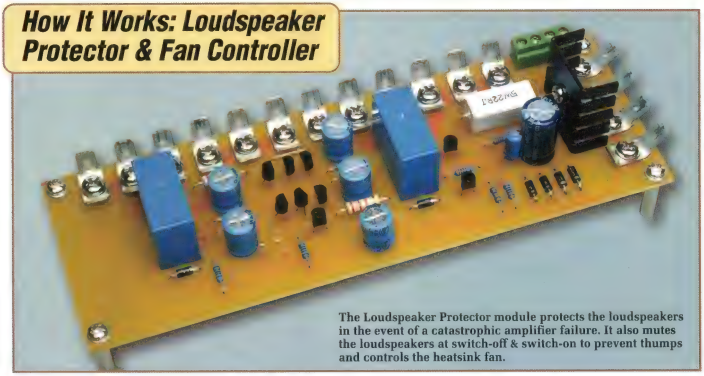
The current through Q17 is limited to around 6.5A peak by the three paralleled 15Ω resistors in its emitter circuit. This peak current is very brief and occurs only while the 100µF capacitor at the output of REG1 is charged up to around 40V. From there on, the LM317 takes over and Q17 switches off.

The same process occurs for the negative regulator REG2, with NPN transistor Q18 taking care of the charging current for the associated 100µF output capacitor.

Low voltage windings

As shown on Fig.4, the transformer also includes two 15V secondary windings. One of these windings feeds two half-wave rectifier circuits on the preamplifier module (see Fig.2), while the other feeds a full-wave bridge rectifier on the loudspeaker protector module (see Fig.5). The rectifier outputs in turn feed 3-terminal regulators to derive ±15V & +12V rails.

How It Works: Loudspeaker Protector & Fan Controller



The Loudspeaker Protector module protects the loudspeakers in the event of a catastrophic amplifier failure. It also mutes the loudspeakers at switch-off & switch-on to prevent thumps and controls the heatsink fan.

FIG.5 SHOWS the Loudspeaker Protector & Fan Controller circuit. This has several functions:
(1) it provides muting at switch-on and switch-off, to prevent thumps from the loudspeakers;
(2) it protects the speakers against catastrophic failure in the amplifier; and
(3) it provides temperature control for the fan-cooled heatsink, switching the fan on if the heatsink temperature rises above 60°C.

The main reason for incorporating speaker protection into an amplifier is to prevent further damage in the case of a serious amplifier fault. In the Ultra-LD amplifier, the main supply rails are ±55V DC. This means that if one of the output transistors fails and there's no loudspeaker protection, more than 50V DC would be applied to the speaker's voice coil. In a nominal 8Ω speaker, the voice coil has a DC resistance of around 6Ω and so the power dissipation would be around 400W until the supply fuse blew.

In the meantime, this amount of applied DC power is likely to push the voice coil out of its gap, damaging the voice coil and suspension in the process. And if the on-board supply fuse didn't blow fairly quickly (a strong possibility since a current of around 8.5A may not blow a 5A fuse straight away), the voice coil would quickly become red-hot and could set fire to the speaker cone material.

This risk applies to any audio power amplifier of more than about 40W per channel. So a loudspeaker protection circuit is a good idea.

Circuit details

As shown in Fig.5, each channel of the amplifier is connected to the NC & NO (normally closed & normally open) contacts of a relay. The relay wipers and NC contacts then each respectively connect to the positive and negative loudspeaker terminals.

Each channel of the amplifier is monitored for DC faults by a triplet of transistors – Q1, Q2 & Q3 for the left channel and Q4, Q5 & Q6 for the right channel. We'll just talk about the left channel here, since the circuit for the right channel is identical.

In operation, the active signal from the amplifier's left channel is fed to a low-pass filter consisting of three 22kΩ resistors and two 47μF bipolar (BP or NP) electrolytic capacitors. This filter network removes any audio frequencies and just leaves DC to be monitored by the three transistors. This is done because we don't want audio signals to trip the protection circuit.

The low-pass filter output is connected to the emitter of Q1 and to the base of Q3. Q1 monitors the amplifier output for negative DC signals while Q3 monitors for positive DC signals.

Q3 turns on if a DC signal of more than +0.6V is present. Similarly, Q1 turns on if a DC signal of more than -0.6V is present on its emitter. This, in turn, pulls Q2's base low and so Q2 also turns on.

Q2 & Q3 have a common 56kΩ collector load resistor (R1) which normally feeds base current to Q7. If the headphone socket switch is closed, this means that Q7 normally is on. And that means that LED1, Q8 and relays RLY1 & RLY2 are also on.

However, if Q1 or Q3 is turned on by an amplifier fault condition, Q7's base is pulled low and so Q7, Q8 and the relays all turn off, disconnecting the speakers. Diodes D5 & D6 protect Q8 by quenching any back-EMF spikes that are generated when the relays are switched off.

Q4, Q5 and Q6 monitor the right channel of the amplifier and they switch Q7, Q8 and the relays in exactly the same manner.

The relays selected for the job have contacts rated at 10A and there are two reasons for this. First, we want the contact resistance in the relays to be as low as possible so that it has negligible effect on the amplifier's performance, in respect of distortion, damping factor and so on.

Second, the relay contacts have to pass and break the heavy DC currents which would otherwise flow through the loudspeaker if a fault occurs in the amplifier. Note that we don't merely use the relays to disconnect the am-

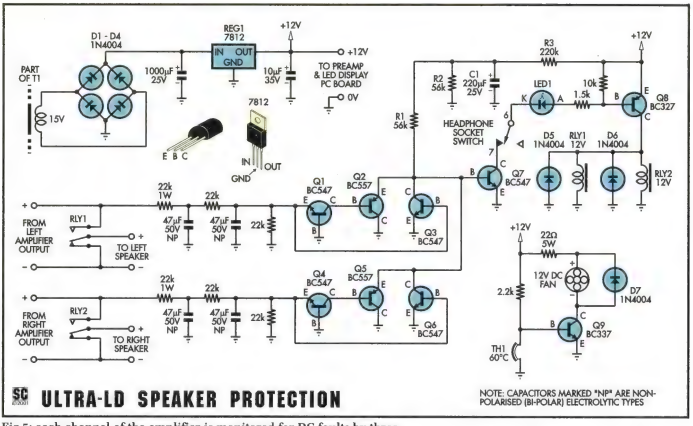


Fig.5: each channel of the amplifier is monitored for DC faults by three transistors – Q1, Q2 & Q3 for the left channel and Q4, Q5 & Q6 for the right channel. If a DC signal is detected, Q7's base is pulled low and this turns off Q8 and the relays.

plifier's output from the loudspeakers. If we simply did this, it's possible that the contacts would just arc across and so the heavy DC current would continue to flow through the loudspeaker.

That might seem unlikely but when you have a heavy DC current and a high DC voltage pushing it along, it can be quite hard to break the circuit. This problem is solved by shorting the moving relay contacts to the loudspeaker ground lines (via the otherwise unused NC contacts) when the relays turn off. This diverts the arc current to chassis and ensures that the fuses blow on the amplifier.

Muting delay

The muting function is achieved using resistors R1 & R3 and capacitor C1 (220µF). When power is first applied, C1 is discharged and so no base current can flow to Q7 via R1. C1 then charges via resistor R3 (220kΩ) until, after about three seconds, enough voltage is present to allow base current to pass via R1 to Q7. This turns on Q7 which then turns on Q8 and the relay to connect the loudspeakers.

If power is removed from the protection circuit, the relay opens within less than 0.5s and this prevents any turn-off thump from being heard.

Loudspeaker switching

Another function of this circuit is to turn off the loudspeakers when the headphones are plugged into the headphone socket.

When this happens, the normally closed contacts (pins 6 & 7) in the headphone socket are opened and this removes the drive to Q8. As a result, Q8 turns off and so the relays also turn off and disconnect the speakers.

Fan control

Temperature sensing for the fan control is based on a 60°C thermal cutout which is bolted to the centre of the main heatsink, between the two power amplifiers. This thermal cutout controls transistor Q9 which in turn switches the fan on and off.

The thermal cutout has a set of normally closed contacts and so Q9's base is normally low. This means that both Q9 and the fan are normally off.

However, if the heatsink temperature rises above 60°C, TH1's contacts open and Q9's base is pulled high by a 2.2kΩ resistor. This turns Q9 on to run the fan. The fan is fed via a 22Ω 5W resistor so that it does not run at full speed. This makes it quieter but it still pumps a fair amount of air through the tunnel heatsink.

When the heatsink subsequently cools down to around 40°C, the thermal cutout closes again and the fan is switched off. Note that 40°C is relatively cool, so the fan will usually run for a long time after it comes on.

At normal listening levels, the heatsink only rises a few degrees above ambient and so the fan should rarely (if ever) come on. And even if it does, it operates so quietly that you won't be aware that it is running.

Power supply

Power for the Loudspeaker Protection circuit is derived from a 15V AC winding on the power transformer. This feeds a bridge rectifier (D1-D4) and the resulting 20V DC rail is then filtered using a 1000µF capacitor and fed to 12V 3-terminal regulator REG1.

Finally, the regulated +12V rail from REG1 is filtered using a 10µF capacitor. This rail powers the Loudspeaker Protector board, as well as the LM3915 display drivers and the LED bargraphs on the preamplifier board. **SC**

A NEW NEON T
FOR YOUR NE

Our last neon tube modulator for cars (SILICON CHIP May 1997) proved quite popular, but what do you do if you don't have a sub-woofer output from your stereo system to drive it? This latest version solves that problem.

As well, the original unit turned off the neon tube for each bass beat but some readers wanted the neon to fire on the beat. This unit can do both.

Oh! You **do** have a sub output on your system but you'd like to use this updated circuit? No worries, just omit three capacitors and off you go.

How it works

As you can see from the circuit (Fig.1) and photograph of the PC board there isn't a lot to it. One IC, three transistors, a couple of diodes and a small handful of resistors and capacitors and its done.

The Left and Right channel inputs are fed via a 0.47µF electrolytic capacitor to the inverting input of IC1a and they appear at the output, pin 1, as a summed inverted signal.

The 0.47µF capacitor along with the 10kΩ input resistor value form a single-pole high-pass filter; the response will roll off at 6dB/octave below 33Hz.

Trimpot VR1 controls the gain of IC1a over a 16:1 range from 0.33 to 5.3. The non-inverting input, pin 3, is connected to the 6V rail and this voltage is propagated through IC1b to the base of Q1.

IC1b is configured as a 2-pole low-pass filter set to roll off at 150Hz. Its response, together with the 33kΩ resistor at its output and the .047µF capacitor, give a flat response from

by Rick Walters

very low frequencies up to 150Hz where the output is 3dB down. The response falls at 18dB per octave above this frequency. Thus the frequencies at the base of Q1 are predominantly those above 20Hz and below 200Hz (see filter response Fig.5).

If you wish to use the circuit in conjunction with a subwoofer, you do not need the low-pass filter based on IC1b. The easiest way to eliminate this filter is to simply leave out the three capacitors (0.1µF, .047µF and .022µF) associated with it, although it will make very little difference to the display either way.

With the DC level at the base of Q1 being in the vicinity of +6V and its emitter also at +6V, it will normally be turned off, but any signal with an amplitude above 6.6V will turn it on. Our bass beat note does just that for us.

IC1c and IC1d are wired as a monostable (one stable state). With no input signal, pin 13, the inverting input of IC1d, sits at about 5V due to the voltage divider action of the 120kΩ resistor to 6V and the 470kΩ resistor to ground.

As the inverting input is at a lower voltage than the non-inverting input (pin 12), the output, pin 14, will be near 12V.

The 47kΩ and 82kΩ resistors hold the inverting input of IC1c at +7V which ensures that its output, pin 8, is near ground. Each of these outputs is connected to the base of an N-channel FET (Field Effect Transistor) via a

UBE DISPLAY
T SOUNDOFF!

4.7kΩ resistor to hold it either normally on (Q2) or normally off (Q3).

Thus the neon tubes connected to pin 2 on the output connector will normally be illuminated and those connected to pin 3 will normally be extinguished.

When the base of Q1 is taken more positive than the emitter it will turn on and the collector voltage will fall from 12V to 6V.

This 6V negative step will be transferred to pin 9 of IC1c, via the .01μF capacitor, and pull it down from 7V to 1V, thus causing pin 8 to rise to near 12V.

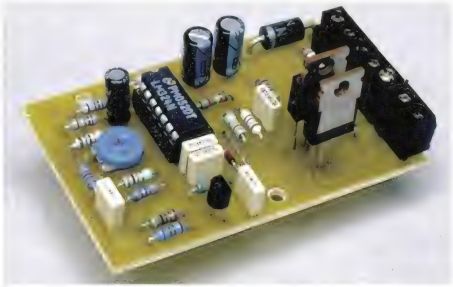
This will turn Q3 on and also raise pin 13 of IC1d from 5V to around +17V, via the .082μF capacitor. Thus its output will fall to ground and Q2 will turn off.

The capacitor at the collector of Q1 will rapidly discharge but the potential at pin 9 will remain near 0V as pin 14 is now also close to 0V.

The outputs will stay in their triggered (unstable) states while the .082μF capacitor slowly discharges. When the voltage at pin 13 falls below 6V pin 14 will revert to its high state (12V), causing pin 9 to revert to 7V and thus pin 8 will fall to 0V (the original stable state). This time delay is set by the .082μF capacitor and the parallel value of the 120kΩ and 470kΩ resistors.

Diode D2 and the 68kΩ resistor hold the base of Q1 high, keeping it turned on and preventing any audio signals from re-triggering the monostable.

To enable you to test the PC board without any neon tube being connected we have provided a LED to mimic the tube's response. It is wired in parallel with the normally on neon



The unit doesn't have a case: we left that part up to you because every installation will be different. Some may simply heatshrink the PC board and conceal it under the dash with some cable ties to hold it in place.

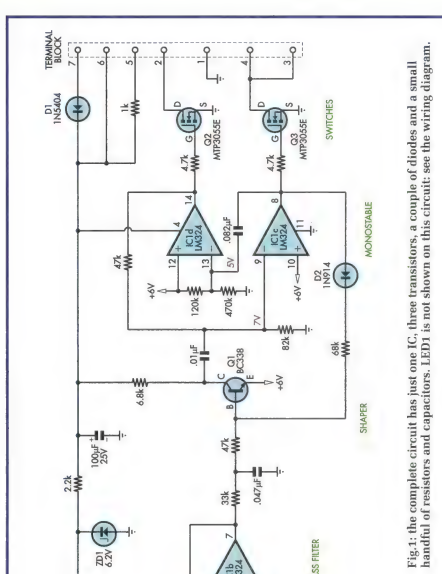


Fig.1: the complete circuit has just one IC, three transistors, a couple of diodes and a small handful of resistors and capacitors. LED1 is not shown on this circuit: see the wiring diagram.

tube and it should light when power is applied to the PC board. A small terminal strip has also been fitted to the board edge to allow easy connection of the battery, the LED and the neon tube leads.

Putting it together

The first step is to check the copper pattern on the PC board against the magazine artwork, looking for bridges between tracks or cuts in the tracks. While such defects are unusual in commercially made boards it is easier to check for such before the PC board is assembled.

The next step is to fit and solder the resistors and diodes. Use a multimeter to check the resistor values as sometimes, depending on the body colour, the band colours can be very difficult to identify.

Follow with the IC socket (if used) or the IC. Ensure pin 1 faces towards the Zener diode. Now add the trimpot, the capacitors and lastly, the terminal strips and FETs.

Solder three wires, two for the audio inputs and one for the earth, to the PC stakes.

That completes the PC board assembly. We have deliberately not mounted the PC board in a case because every installation will be different.

In most cases, we imagine the board will be "hard wired" into the car's electrical system, in which case the board could simply be heat-shrunk and secured up under the dash with a cable tie.

On the other hand, some constructors may wish to mount the board in a case (perhaps for portability), complete with RCA or similar sockets for the input. We'll leave this side of it completely up to you.

Testing it.

Connect the LED anode (longer lead) and cathode to the second and fifth terminals on the terminal strip. Connect the positive 12V lead either from a power supply or car battery to the seventh terminal and the negative lead to the first.

Connect an audio source to the input – just one channel is fine for testing.

The best source of audio is a tape recorder or CD player because when you (shortly!) connect the neons up, you'll probably find the RF interference they generate will obliterate any nearby radio signal!

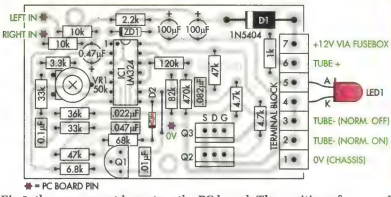
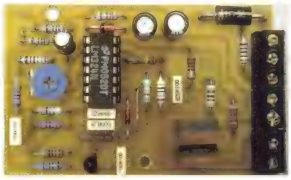
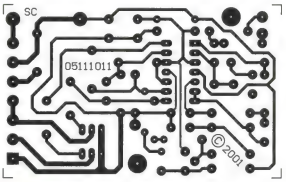


Fig.2: the component layout on the PC board. The position of the LED shown here is in the "normally off" position – moving the cathode to terminal 2 should make it normally on.



For comparison, here's a same-size pic of the completed PC board, with the pattern shown below.



While listening to the music adjust the trimpot until the LED flickers off in time with the beat.

You'll need a reasonable amount of level to make the circuit work – if the LED stays on (ie, doesn't flicker) wind the wick up on your stereo and/or set the pot at its maximum.

You may have to reset this control to accommodate the different input level when you fit it in your vehicle.

If you swap the LED over to the fourth and fifth terminals, the LED should be flickering on (as distinct from flickering off) in time with the beat.

Finally, the LED can be removed or it can be left in circuit – it doesn't matter either way. If you wish to dress it up with a bezel, it could make a neat dashboard indicator, showing the pulses the neons are working to!

Parts List – Neon Tube Modulator

1 PC board coded 05111011, 75mm x 46mm
1 plastic box 59 x 109 x 34 (Jaycar HB-6025 or equivalent)
2 RCA chassis mounting sockets
1 3-way terminal strips (Jaycar HM-3173 or equivalent)
2 2-way terminal strips (Jaycar HM-3172 or equivalent)
1 neon tube (pair), Jaycar ST-3130 (red) or ST-3134 (blue) and/or ST-3138 bicolour neon tube
2 5mm x 3mm threaded spacers
2 3mm x 8mm countersunk bolts
2 3mm nuts

Semiconductors

1 LM324 quad op amp (IC1)
1 BC338 NPN small signal transistor (Q1)
2 MPT3055E N-channel MOSFETs (Q2, Q3)
1 1N5404 3A diode (D1)
1 1N914 small signal diode (D2)
1 3mm or 5mm red LED (LED1)

Capacitors

2 100µF 25VW PC mounting electrolytic
1 0.47µF 25VW PC mounting electrolytic
1 0.1µF MKT polyester
1 .082µF MKT polyester
1 .047µF MKT polyester
1 .022µF MKT polyester
1 .01µF MKT polyester

Resistors (0.25W, 1%)

1 470kΩ 1 120kΩ 1 82kΩ 1 68kΩ 2 47kΩ 1 36kΩ
2 33kΩ 2 10kΩ 1 6.8kΩ 2 4.7kΩ 1 3.3kΩ 1 2.2kΩ
1 1kΩ
1 50kΩ trimpot (VR1)

Won't work!

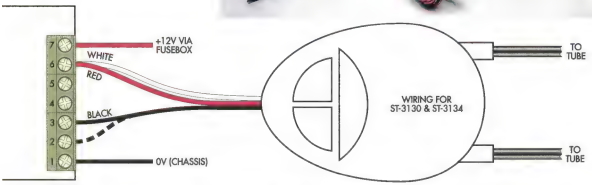
If it doesn't appear to work, the first check is to make sure that you actually fitted the LED with the correct polarity. The LED should be lit when across terminals two and five. Shorting the drain of Q2 to its source should cause the LED to light. If it does not, either the LED is faulty or in backwards. Once you get the LED to light with the short it should stay lit with the short removed. Check that the voltages on pins 9 and 13 are as shown on the circuit. If this is not the case, check each resistor value around IC1c and IC1d and check your soldering.

Once the monostable is working you can check the audio with a multimeter set to read AC volts.

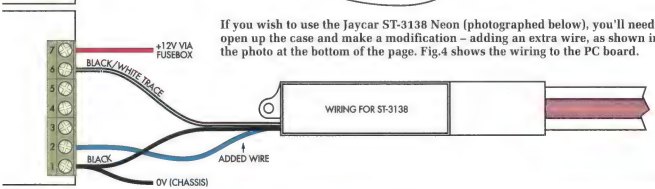
Table 1: CAPACITOR CODES

Value	IEC Code	EIA Code
0.1µF	100n	104
.082µF	82n	823
.047µF	47n	473
.022µF	22n	223
.01µF	10n	103

The circuit was originally designed to run with this Neon Tube set from Jaycar. Its wiring is shown below (fig.3). Again, moving the black lead from the No 3 terminal to the No 2 terminal turns the neons from normally on to normally off.



If you wish to use the Jaycar ST-3138 Neon (photographed below), you'll need to open up the case and make a modification – adding an extra wire, as shown in the photo at the bottom of the page. Fig.4 shows the wiring to the PC board.



Starting at the audio input and tracing through the circuit, pin 1 of IC1a should typically have a signal of around 1VAC with a normal input and VR1 fully clockwise and depending on the program material, a slightly lower voltage at pin 5.

The same voltage should be measured at pin 7 of IC2b and a little less at the junction of the 33kΩ resistor and the .047μF capacitor. As long as you get a reading at each point you need not worry too much about the exact value. Careful checking of your work should show up the problem.

The board is capable of driving 8-10 ST-3130/4 neon tubes so you can wire some normally on and others normally off to get the exact effect you want.

Go out and knock them out at your next sound-off.

The extra wire (blue) is soldered to the switch in the position seen here. See the text for a more detailed explanation.

For the serious car buff!

While browsing the Jaycar catalog looking for the part number for the above tube we came across another one that intrigued us, the ST-3138. It features a 3-position switch which can select colour 1 (C1), colour 2 (C2) or fade from colour 1 to colour 2 and back, on a continuous basis (CC).

While the fade function didn't work very well on our sample, our idea was to have one colour selected and let the beat change it to the other colour, then after the delay the tube would revert to the first colour.

You will have to be a bit adventurous if you want this type of display as the tube's electronics are in a sealed plastic case. A hobby knife around

the edge soon had the lid off. Our unit had two wires, one red, one white joining pads on the PC board to the switch. The red wire went to the position on the switch marked C2. By selecting C1 this red wire was grounded.

Selecting C2 switches to the pink neon colour which changes to blue when the red wire is grounded. Just what we need!

The cigarette lighter plug was chopped off and the striped black lead run to the battery supply (terminal 2). The plain black lead was connected to the battery negative (terminal 7) along with the battery lead. A wire was soldered to the red wire termination and taped to the black fig.8 lead. It was terminated on the normally off terminal (6). This is all shown clearly in the photograph.

There is no reason why you can't mix and match both types of neons. The main limitation is the current capacity of D1 (3A maximum). By connecting the positive leads of the neons to the battery positive terminal instead of through the diode, the limitation becomes the voltage drop across each FET. With an on resistance (RDS_{ON}) of 0.15Ω you can safely draw 2-3A through each FET without a heatsink. With a decent heatsink you could probably double this.

We measured the current consumption of the samples and found that the pair of ST-3134 tubes drew 250mA and the bicolour tube drew 130mA on pink and 90mA on blue.

Armed with this information you can figure out your display requirements and how you will have to wire the tubes. **SC**

Table 2: RESISTOR COLOUR CODES

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	470kΩ	yellow purple yellow brown	yellow purple black orange brown
1	120kΩ	brown red yellow brown	brown red black orange brown
1	82kΩ	grey red orange brown	grey red black red brown
1	68kΩ	blue grey orange brown	blue grey black red brown
2	47kΩ	yellow purple orange brown	yellow purple black red brown
1	36kΩ	orange blue orange brown	orange blue black red brown
2•	33kΩ	orange orange orange brown	orange orange black red brown
2	10kΩ	brown black orange brown	brown black black red brown
1	6.8kΩ	blue grey red brown	blue grey black brown brown
2	4.7kΩ	yellow purple red brown	yellow purple black brown brown
1	3.3kΩ	orange orange red brown	orange orange black brown brown
1	2.2kΩ	red red red brown	red red black brown brown
1	1kΩ	brown black red brown	brown black black brown brown

Fig.5: The filter gives a flat response from very low frequencies up to 150Hz where the output is 4dB down. The response falls at 18dB per octave above this frequency. Thus the frequencies at the base of Q1 are predominantly those above 20Hz and below 200Hz.

AMD 1GHz Processor Runs At The Wrong Speed

Q I am building the "PC To Die For" as described in the June & July issues of SILICON CHIP and I have an AMD A1000AMT3C (1GHz) processor and an Asus A7V133C Rev 1.05 motherboard with Rev 1005A BIOS.

In jumper-free mode the BIOS is incorrectly reporting a 750MHz processor. I have visited the Asus website and have noted that numerous people are having the same problem but very few suggestions on how to rectify it.

I was wondering if you were aware of this problem and/or any remedies. I am loathe to tackle the jumper settings as I do not know the FSB (front side bus) frequency, multiplier and core voltage settings for this processor. (N. E.)

A Your 1GHz Athlon processor has a 266MHz front side bus (FSB), as opposed to the lower-specced version which runs with a 200MHz front side bus

This means that you have to change the "CPU Frequency" setting in the system BIOS from 100MHz to 133MHz. To do that, go to the "Advanced" menu screen in the system BIOS (see page 16 of the July 2001 issue) and change the "Operating Frequency Setting" entry from "Standard" to "User Define". This done, you can then change the "CPU Frequency" from 100MHz to 133MHz. The "CPU Clock Multiplier" setting should be 7.5 (ie, 7.5 x 133 = 1000, or thereabouts).

That's it – you can let the system auto-detect the Vcore (core voltage) for the processor. You don't have to play around with jumpers on the motherboard and indeed it's preferable not to unless you are very experienced.

The reason your system is currently limited to 750MHz is because the Standard setting locks the bus frequency to 100MHz and, in addition, the CPU has its multiplier locked (to 7.5 in this case) – ie, 7.5 x 100 = 750MHz.

Video cards & shared IRQs

Q I am experiencing problems with a Via chipset motherboard-based PC. When running programs that use the soundcard, it can crash.

The TNT2 M64 video card and the soundcard both share IRQ11. I have IRQ 5 free and tried to reassign one of the cards to that IRQ. However, when I de-select "automatic settings" to allow me to edit the IRQs and memory addresses, Windows tells me that I cannot change the setting.

If this IRQ "conflict" is the source of my problems, how can I get around it?

On my other PC, a Gigabyte-based PC, IRQ 11 is shared with the same type of video card and a Realtek network card (installing the network card on the other PC is what started a whole raft of seemingly unresolvable problems).

Any suggestions that can help me eliminate this problem will be appreciated. If the IRQ sharing is causing a conflict, how do I get around it? (M. T.)

A It sounds like you're using the first PCI slot on both PCs (note: subsequent feedback indicated that this was indeed the case). Many motherboards force the AGP (video card) slot to share an IRQ with the first PCI slot but video cards often don't like sharing an IRQ.

If you have a soundcard or network card plugged into the first PCI slot, try moving it to another slot (eg, slot 3 or 4). That way, the card should grab one of the free IRQs.

In fact, it's always best to leave the first PCI slot free if you are using an AGP video card, to avoid IRQ conflicts. The first PCI slot is used only if you don't have an AGP video card (or if the card is happy to share).

If you are using Windows 98/Me, make sure that you have PnP OS enabled in your system BIOS. Also, don't assign fixed IRQs to any of the PCI slots – set this to Auto instead and don't reserve any IRQs for legacy devices (unless you have ISA cards).

By the way, it's standard practice under Windows 98/Me to remove the relevant drivers (in Device Manager) before removing an item of hardware, even if you are only moving it from one PCI slot to another.

Don't do too much at once. Get the system working with the video card first and make sure it's stable. Then add the sound card and make sure this is working before installing the network card.

It's also a good idea to download and install the latest Via 4-In-1 drivers since your motherboard has a Via chipset, plus any driver updates for your sound card.

ICS & thin ethernet networks

Q I have been following your articles on home networking for sometime and found them very helpful. The December 2000 issue covered shared internet connections for star topology home networks. Is it possible to use Windows ICS for daisy-chain topology; ie, thin ethernet 75-ohm coax, BNC home networks? (G. M.)

A Yes, you can use ICS with a 75-ohm coax (10-Base200) network. You set it up in exactly the same way as for a star network. It's the networking protocol (ie, TCP/IP) that's important here, not the network topology.

Checking your email from another PC

Q I'm having trouble with my computer and am unable to access my email. Therefore, I am trying a friend's computer. Is it possible to access my email account from a remote computer and if so, how? (L.S.)

A Provided your ISP supports this facility, the easiest way to access your email from a remote computer is to point the web browser to **www.mail2web.com** (ie, using Internet Explorer, not the email client). Enter in your email address and password when prompted and the site will list all the emails in your POP3 mailbox. You can then download these, read your mail and even delete mail from the POP3 box.

Another way is to create a new email account on your friend's computer. By doing this, you will be able to dial into his/her ISP in the normal manner and retrieve mail from your ISP's POP3 mailbox. Assuming that you're using Outlook Express, click Tools, Accounts, Mail, Add and follow the wizard to set up the account. You must enter your ISP's mail server address for the POP3 server but the SMTP server and any other settings should be the same as that used by your friend. Of course, you must use your own name and email address where required.

Another method is to set up an additional dial-up connection on your friend's machine, so that you can connect to your own ISP. To do this, double-click My Computer, double-click Dial-Up Networking, double click Make A New Connection and follow the wizard to set up your Internet account and email exactly as you originally did for your own machine. When setup is completed, an additional dial-up icon will appear on the desktop and you can then choose which ISP you want to dial.

Getting rid of the log-on password

Q I recently decided to network my two computers so I bought two identical network cards at a computer swap meeting, together with the necessary cable and fittings. I fitted the cards, ran the cable, then installed the network on the Win95 machine.

It worked like a charm – Windows 95 found the network card, installed the necessary drivers or whatever, then told me it was ready to go. Only problem is that now I have to enter a *!@? password every time I boot the machine! (J. L.)

A No, you don't have to do that. If you specified a password when you set up the networking, simply change it to no password by double-clicking the passwords icon in Control Panel, then clicking the "Change Windows Password" button. Enter your old password, leave the "New Password" and "Confirm New Password" fields blank and click OK.

That done, double-click the Network icon in Control Panel to launch the Network configuration dialog box. Click the down button for the "Primary Network Logon" and choose "Windows Logon" from the list. When you reboot – voila! – no more *!@? password required (note: you may have to reboot twice – once for the changes to take effect).

Freesco – A Simple Linux Internet Gateway

Looking for a simple Internet gateway to share an Internet connection? Then take a look at Freesco available at **http://www.freesco.org**. Freesco is a single diskette (1.44Mb) Linux Internet Gateway with all the necessary bells & whistles (runs in less than 6Mb RAM and includes DHCP, NAT, named and telnetd). I run it on an old Pentium P75 with 16Mb of RAM & 56Kb modem and it supports my five workstations running a variety of Internet application simultaneously – **Stephen Wright, VK2KHA**.

Connecting drives to the Asus A7V-133 motherboard

Q I enjoyed the article on "A PC To Die For" but changed some of the components for my PC (although it's basically the same).

If I understand it right, the Asus A7V-133 motherboard has two IDE controllers: Via and Promise. Does this mean that I can run both of my CD drives as master units (one on each controller), rather than as master and slave? I currently have the burner drive as the master and the CD-R as the slave. The hard disk drives (HDDs) are master/slave. (N. L.)

A Yes, you can run both CD drives as masters – just put one as master on the primary IDE port and the other as master on the secondary IDE port. In fact, this is the way to go if you want to copy to a CD-ROM burner.

The two hard disk drives can be run from the Promise Ultra ATA100 ports. You can either run them as master/slave as you have done or, better still, run them both as masters – one on each port.

Internet Connection Sharing and MIRC

Q I have a network set up with Internet Connection Sharing, with the ICS computer connected to a cable modem. Everything works fine except when I try to send direct connect chats using MIRC or any other chat software. People can send me messages but I can not chat from the networked computers. However, I can do so OK from the ICS computer direct, or when I dial out from one of the workstations.

Any ideas on how I can get these chats to work properly? (F. K.)

A Go to www.yahoo.com and search for "ICS AND mirc" (without the inverted commas). You'll find lots of information on working around your problem. No guarantees though – we haven't tested the solutions offered.

SERVICEMAN'S LOG

Ring every day until it's fixed

Most customers are reasonably patient while an appliance is in dock. Some are even apologetic. But others, particularly when a new and expensive device is concerned, demand – almost hourly – that it be fixed yesterday.

This story was contributed by a colleague working for a Sony Service Centre. In line with most modern service centres, field or home service nowadays consists of simple installation tasks, or just collection and delivery by apprentices. The weight and bulk of modern sets usually requires at least two men to handle them, though I have seen a TV trolley to do the job.

This trolley is fitted with suction cups and a wind-up mechanism to raise and lower a set of up to 140kg. Unfortunately, its biggest disadvantage is its cost; around $1400 but as the salesman said, it's still probably a lot cheaper than a bad back.

But that aside, the main complaint about warranty repairs is listening to a whingeing customer and trying to convince him that he is not really entitled to a new set. And understandably, most cannot comprehend why their latest technological marvel has failed when it is barely out of the egg.

The good side is having the ear of the manufacturer's technical officers and their ability to arrange for spare parts to arrive promptly. In addition, one is supplied with brand new original service manuals and can often attend courses on new models.

Sony KV-ES34M31 TV set

Anyway, this is my colleague's story, as he tells it. It concerns an 80cm flat tube Sony KV-ES34M31, employing a AG3 chassis. The customer was annoyed when it failed within months of buying it. The 84kg set was gingerly placed in the middle of my bench by the delivery team and left for me to fix – with an instruction from the Sony Technical Officer to fix it urgently.

The set, though dead, was able to indicate this via its Standby/Timer LED flashing an error code. In this case, it was flashing twice, which means "I'm dead". Isn't technology wonderful? – a device designed to indicate the bleeding obvious.

But to be truthful, it actually does offer worthwhile diagnostic clues – according to the service manual, the probable cause was that the horizontal output transistor Q6807 and Q6810 pin-out transistor, (both 2SC5480-01) were short circuit. I removed both and found that Q6807 was indeed short circuit but Q6810 was OK.

Because the customer was making such a noise about his set, the Technical Officer was on the phone every few hours enquiring about my progress. Not having seen this set before, I asked him what was the likely cause of the transistor failure? He replied that it was usually the horizontal output transformer. In any event, he suggested I replace both transistors, in case the other one was weakened by the stress of the failure.

I had two new transistors by the next day and after fitting them and switching the set on, nothing happened except that the one-eyed beacon on the front of the set flashed six times. This suggested that the EHT was too high because capacitor C6831 was open circuit (or CN6101 on the D1 board is disconnected).

This was puzzling, as there was no EHT at all. In fact, there was no horizontal drive (HD1) coming into the D board from CN6800 pin 13 or from CN4101 pin 4 from the E board (RGB out, deflection). However, all was revealed when I removed and examined the E board to find that a whole series of surface mounted transistors had been literally blown apart. I was onto the Technical Officer quick smart.

The next day, after reassuring the client that his set was receiving attention, I fitted a new module which Sony had quickly supplied. And Sony weren't messing about – they wanted it fixed as quickly as possible. And they weren't interested at this stage in fixing it at component level, unless it was on a major assembly. Unfortunately, the horizontal output transistor blew up again when power was applied and the standby lamp was back to two flashes.

The next day, after suffering another call from our customer, another two transistors and a new horizontal output transformer (T6803) were fitted.

Phew! – at last a picture and sound. The width was a little low, probably due to the new components, so I readjusted it by writing new values under GEO 044 HSZ in the Service Mode with the remote control.

I thought that that would be the last of it – except that, with the brightness and contrast turned up more than 80%, the width would shrink 50mm on each side. There was obviously still something wrong, most likely in the automatic brightness limiter circuitry.

Items Covered This Month

- Sony KV-ES34M31 TV set.
- Pansonic TC-68P22A TV set.
- Orion Triade 34 TV set.
- Ryobi 12V cordless drill battery charger.

I traced the circuit back from pin 11 of the horizontal output transformer with a multimeter. Finally, I reached R6866, a 2.7kΩ resistor, which measured nearly 100kΩ. Replacing it fixed the problem but I now had to reset the horizontal size to where it was before.

Though the fault proved to be an interesting exercise, the client's tactic of ringing every morning was a bit annoying. It annoyed the Technical Service Officer too!

Panasonic TC-68P22A TV set

The next story concerns a Panasonic TC-68P22A using an MX-8 chassis. This set was just out of warranty and came in for a dark picture.

As it was only slightly out, it could be readjusted in the Service CHK2 and CHK4 modes. This is done by simultaneously pressing the RECALL button on the remote control and the Volume Down button on the set's front panel, to get into the "Market Mode". The selection of the CHK mode is made using either button 1 or button 2 on the remote control. The sub-brightness level can be adjusted with buttons 3 or 4 and vol6 and memorised by button 0. The typical value is 2DH and why it is in two different menus is beyond me.

There is a more advanced technical procedure to set the sub-brightness to 2.3V on TPA1. This involves shorting TPA57 to TPA50 and J67 to TPA32. However, the service manual can't quite make up its mind which CHK mode to be in. It suggests CH3 and the data to be 63, which contradicts what it says earlier.

Anyway, I set it for the default value which was fine but I found it was unable to store this. There was nothing for it but to order and fit a new EEPROM IC (1102 24LC08BIPA22). I did this and then reprogrammed the option codes in the CHK1 menu.

Fortunately, it all worked well. The fault was fixed and after a few days soak testing it was returned to the customer. Two weeks later, the same set was returned for a rework as there was now a new fault. The greyscale was out and it was again too dark. Going through the menus again, I found that the red cut-off data in the CHK4 white balance adjustment mode was corrupted. Again, it wasn't difficult to reset these levels and soak test the set.

Firware upgrade

Another two weeks passed before an understandably upset customer brought the set back again with the same problem. At this stage, I decided to have a chat with the Panasonic Technical Officer who advised me of a CPU (microprocessor unit) firmware upgrade for this chassis. (Firmware is the program which carries the various settings – brightness, contrast, picture geometry, etc. Once set, it should not vary).

Apparently, this modification is aimed at the firmware setting of early production sets (1999), whereby it is possible for the customer to access cut-off and sub-brightness settings without knowledge of doing so.

What irony! We had only just fitted a brand new EEPROM, supplied by Panasonic, that was two years out of date. Basically, if a customer watches Channel 9 a lot, sooner or later he will press the combination of control buttons that will bring on this fault. Technical Information Sheet (Order No.

T0001MX8-2) gives a table for new data in the CHK1 Option Code menu which will overcome this. However, it is necessary to get into the Memory Edit mode ("vol -" and "mute" buttons) while in the CHK1 menu and then key in the new data.

I soak tested the set for a week before letting it go back – especially testing the Channel 9 remote function.

Two months later, a furious customer returned the set, letting me know in no uncertain terms what a buffoon I was. This time the fault gave an effect similar to old fashioned brown photographs made on printing-out-paper.

I spent a long time going over everything but finally concluded, with the Panasonic Technical Officer's help, that the CPU (IC1101 MN1873284TFI) was corrupting the EEPROM data.

Replacing the microprocessor has, hopefully, finally fixed the problem – at least, I haven't seen the set for three months now!

Conflicting technology

With so much technology in the home these days, it is inevitable that conflicts between technologies would start to arise. At present, our biggest headache is digital transmissions. It is very difficult to explain to Mrs Brown that the new VCR she bought to replace her previous Jurassic model can't tune the stations clearly because of digital co-channel interference.

The other inevitable area of conflict is the remote control. Nowadays, everything has a remote control function. Anyway, because of the huge number of types of remote control systems out there, sooner or later you get one that controls something you don't want it to. One friend has a brand new Nokia 6210 mobile phone which, with certain buttons depressed, will lock his Toyota Landcruiser doors.

Thieves these days use digital scanners and when someone uses a keyless lock it stores the digital pattern and frequency and then can use this to unlock the device later when it is unattended. Some of these crooks cruise around industrial and housing estates using broadband transmitters and see which remote roller doors will open. All new remote systems now use a rolling code, as indeed they do with cars.

Recalcitrant remotes

Another of my friends (I have two!) had an old Philips KL9A1 TV set with remote control and a brand new Sanyo VX800 hifi VCR and kept complaining that the remote controls were intermittently not working – especially the Sanyo.

I called around one day but everything was in perfect working order. This fault continued for weeks and he was starting to get a bit fed up with it all. I took the remote controls to work and dismantled them to check for corrosion, faulty joints and anything else I could find – but everything was perfectly OK so I returned them.

The fault was still there and sometimes he would complain that he couldn't even change the controls manually on the Philips TV set. Every time I looked at them they all worked perfectly and only sometimes did they work for him.

This went on for months and was only resolved when he decided to get on to Optus cable TV and they installed a set-top box and, of course, a remote control.

When they left, it was all working but that night the new control wasn't working and nor were any of the others. It took the Optus service engineer the next day to find the cause of all this trouble.

The problem was due to a Condor Energy Saver 18W fluorescent light. Apparently, it transmits harmonics that were affecting all the remote control receivers. The reason I never saw the fault was that I called around in the daytime when the light was off. And the Philips TV set couldn't operate manually because it was receiving

commands via its remote receiver that had priority.

Ryobi charger

I never cease to be surprised at the confusing problems that can arise in simple equipment. The other day, I was given a Ryobi 12V cordless drill battery charger to fix, the fault being that it wasn't charging.

"Piece of cake" I said, tempting fate. I took the thing to pieces and found that it consisted of no more than half a dozen components – a DC jack input from the AC power adapter and a small PC board which carried a diode, a transistor, a resistor and a LED. It's all incredibly simple.

I measured voltage coming in but none out. It didn't take long to work out that, despite the polarity being clearly marked on the DC socket board and on the PC board, it could never have worked in this configuration. Reversing the wires produced a voltage output but the LED wouldn't light.

I checked the 2SC945 transistor to find it was open circuit. This was replaced and I then checked the remaining three components out of circuit and found that they were OK. The LED even lit OK when tested but it wouldn't work in circuit.

This was ridiculous. I work on complicated circuits all the time but this simple circuit had me stumped. It was totally frustrating.

I reassembled and tried it once more with the battery in its receptacle. And would you believe it? – it was now working properly. I wasn't about to set up a committee to investigate this apparent miracle. Instead, I just mentally thanked whoever it is that controls these things and left it at that.

Thinking about it later, I concluded that the chrome-plated springs in the battery receptacle weren't making proper contact with the battery before everything was reassembled. But really, in the scale of things, it's not that important – far better to concentrate on the Big Bang theory and ask what happened before the bang and who set it off?

Postscript: the customer returned this unit sometime later and I discovered that the reason that the battery holder was wired the wrong way was because the AC power pack originally supplied to me was the wrong one. I was given a 9V one, not the correct 12V one that comes with this unit. The tips of the DC plug are opposite for each voltage.

This probably accounted for why the transistor was blown too."

Orion Triade TV set

I was pleased to find that the Orion Triade 34 TV set was already on my bench because that meant I didn't have to lift it. It's bad enough getting old but to have a bad back as well would surely be the end.

Fortunately, in my case it's just senility and Alzheimer's that are my only problems – I still have my looks!

Back to reality. The Orion Triade is an Italian-made 79cm TV set, model 346A4 T8007PIP using the "Professional 7000" chassis. It is a large set with only one visible control (the on/off switch) and three other push-

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buttons concealed behind a door on the righthand side.

This one was dead and I had no remote control or instruction booklet. The good news was that I did have a circuit diagram. Despite it being such a huge set, the chassis is small and one doesn't have to remove the whole of the back to get to it. Undoing two screws removes a cover for the neck of the tube and the chassis.

To say the set was dead was not totally accurate. When the power was switched on, the set was going into a standby mode with a small red LED illuminating on the front escutcheon.

The three buttons on the side are marked "+", "-" and "menu". I pressed the top one and the set tried to fire up but failed and then went completely dead. All I could do was to switch the power off, wait a few minutes and power it all up again in the same way.

The switchmode power supply is on a self-contained module on the righthand side of the chassis (looking at the rear) but access makes it difficult to measure all the voltage outputs. I removed the supply and connected a dummy load to the 150V rail and 240V AC to its input. The power supply worked OK, so I removed the main chassis and checked for faulty joints and shorts, especially in the horizontal output stage, but could find none.

And yet with the set all back together, there were no voltage outputs in the full-on position. Suspecting the horizontal output transistor, I shorted its base and emitter and checked the collector voltage. This time, the voltage was there.

Because access was poor and I had used a piece of solder to join the two junctions together, I used a meter probe to break the link. To my surprise the set fired up and gave a magnificent picture and full sound. All the functions were working and when I switched the set off and on, it came back up perfectly.

Well, this was all very exciting but I really didn't know what I had done to deserve this. I left the set on for the rest of the day and switched it off at going-home time. The next day, when I returned, the set was dead, as before. I carefully repeated what I had done the day before and managed once more to start the set.

This went on for a couple of days but it was always dead the next day. The problem seemed to me was that it was intermittently unable to start when cold even though all the voltages were there in the standby mode but not in the ON mode.

Four microprocessors

This set has no less than four microprocessors, the control one being ICR2 (uP83COSS SEI 7000). The set is switched on from pin 41 via transistor TR1 after a Power On Resetting interrupt sequence on pins 37, 33 and 42. This voltage is then applied to TP5, TP6 and ICP4, which then connects the 12V and 8V rails to the horizontal oscillator and deflection circuits.

The horizontal sync pulses are sent back to the power supply via an optocoupler (FAP1) and TP4 to the control chip (IVP1 TEA2261, pin 10) to change the switchmode power supply frequency from 23kHz to the 14.5kHz operating condition.

A second optocoupler (FAP2) feeds back the secondary voltage levels to pin 6 of comparator ICP1. This latter stage interested me and the next time it was on, I measured the main 150V rail accurately with a digital meter. This was significantly high at 157V (5% error), possibly enough to trip the protection circuit through FAP2. I reduced PP1 to set the correct voltage precisely.

This indeed made the set easier to start in the mornings but there were still occasions when it wouldn't start and it wasn't good enough to send back to its owner. One thing I did notice was the timing of the various voltages from standby to on – in particular, there was a delay for the 12V to appear on pin 6 of ICP4 (TA8138A). This might be enough to make the horizontal sync pulses build up.

I ordered a new one, making sure I specified one with an "A" suffix because without the A, this IC is a 7-pin in-line type, as opposed to the "Q" formation for which this set is drilled and punched. The new IC finally fixed the problem and after soak testing it for a week, it went back home. **SC**

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VIDEO INTERCOM SYSTEM

FANTASTIC NEW LOW PRICE NEW

See who's at the door or even the front gate before you let them in! The system consists of a small external unit that houses a black & white CCD camera, speaker & microphone. It also has built in infrared illumination to let you see visitors both day and night. The internal unit houses the 4" monitor, handset and control buttons. The intercom doubles as a doorbell. When your visitor presses the button the bell sounds and the monitor switches on and you can talk to the caller. You can then even unlock the door remotely with our optional electric door strike (Cat LA-5078). The system includes a 10 metre long interconnecting cable and plug pack power supply. Cat. QC-3412

"This product used to sell for $489"

$299.50

LED GLOWLIGHT PENS NEW

This attractive and stylish pen not only writes, but incorporates a LED so that you can see what you are writing in any lighting conditions, even total darkness. The pen's clever design allows the light source to be focused at the writing tip yet illuminate the internal features of the clear acrylic barrel. The ball point pen section is retracted with a twisting action & the LED is operated by a click-on /click-off switch mounted on the top. A unique and good-looking pen. Measures 150mm long x 15mm diameter and powered by 2 LR-44 batteries (cat SB-2516) Cat. ST-3065 **Red**; Cat. ST-3066 **Blue**; Cat. ST-3067 **Green**.

$9.95ea

Ideal Christmas Gift

3 LED & BULB HEAD LAMP

NEW

Headlamp style torch with 3 LEDs and a Bi-Pin bulb to provide 3 distinct lighting modes. The headlamp features 'O' rings seals to improve water resistance and an adjustable headband for operator comfort. Weighs less than 135g including the 3 x AAA batteries which are included.

Size approx 45 (Dia) x 60 (L)mm. Use our SB-2425 (Pack of 4) replacement batteries. Cat. ST-3070

$39.95

LED KEYLIGHTS

These tiny keyring torches have proven so popular that we now carry they entire range of colours. Now available in Red. See catalogue page 258 for details.

YELLOW	Cat. ST-3046
BLUE	Cat. ST-3047
WHITE	Cat. ST-3048
GREEN	Cat. ST-3049
RED	Cat. ST-3050

ROBUST KEY RING SUPER BRIGHT WHITE LED TORCH

NEW

This robust aluminium key-ring torch features 'O' ring seals for good water resistance & a single super-bright white LED for bright, long lasting light. It has rubber grips for easy 'twist action' operation and a secure, spring loaded carabineer-style key attachment ring. Requires 3 x 1.5 Volt button cells which are included. Size: 75 (L)x26 (dia)mm Cat. ST-3072

$19.95

1.2V SANYO 600mA 1/2 SUB C Ni-Cd

NEW

We now stock a quality Japanese made, industrial grade cell that is commonly found in some compact electronic devices such as cordless drills, electronic screwdrivers, and electronic toothbrushes. Charging rate: Trickle charge – 15mA for Slow charge – 65mA for 14 - 16hrs Fast charge – 900mA for 1hr Cat. SB-2463

$8.95 or Buy 10 for $7.95ea

YELLOW $9.95
GREEN $9.95 NEW
BLUE $14.95
RED $14.95
WHITE $14.95

THE EASY WAY TO SHOP!

LED SANTA DISPLAY KIT

Build in time for Christmas!

Enhance your Christmas spirit with this exciting LED display kit. The kit uses over 600 high brightness LEDs to create a colourful and eye-catching display which measures almost a metre across. See cat. page 19 for details. Cat. KC-5302

$169

RCA/S-VIDEO REMOTE CONTROLLED SELECTOR / SCANNER

NEW

This quality 4-way source switcher is suitable for use as either a remote A/V switcher for your TV or a channel selector for switching surveillance cameras. Unit features full function remote control as well as a scan function with variable interval time span. Cat. AC-1670

$119

60 Watt 12VDC TO 230VAC POWER INVERTER

SAVE $20

This Powertech inverter is ideal for low power consumption 240VAC appliances up to 60 Watts. 80 Watt surge rate. Measures 80(W) x 165(L) x 35(H)mm. See cat. page 124 for details. Cat. MI-5030

$59.95

WAS $79.95

300W 12VDC TO 230VAC ISOLATED POWER INVERTER

This inverter is electrically isolated between the battery & the secondary and boasts a massive 900 Watt surge rating making it ideal for starting up a computer and monitor. Measures 88(W) x 125(L) x 74(H)mm. See catalogue page 124 for details. Cat. MI-5062

$129.50

SAVE $30

WAS $159.50

1500 Watt 12VDC to 230VAC ELECTRICALLY ISOLATED INVERTER

$679

This inverter is electrically isolated between the battery and the secondary and a hefty 3000 Watt surge rating. Measures 88(W) x 125(L) x 74(H)mm. See catalogue page 124 for details. Cat. MI-5072

SAVE $70

WAS $749

NEW PRODUCTS

Sometimes new products advertised here are held up due to unforseen circumstances. Before driving across town, please phone to check that the new products have arrived in your store.

OVERNIGHT DELIVERY

MAILORDERS - FREECALL FOR PHONE ORDERS - 1800 022 888

OVERNIGHT DELIVERY

CRAZY BIRTHDAY SPEAKER SALE

5" WOOFER RESPONSE

SAVE $10

•Freq Resp: 58-7kHz •8 ohm •Sensitivity: 87dB
Cat. CW-2101
WAS $45

$35

6.5" P17WJ WOOFER

SAVE $20

•Frequency Resp: 37 - 5kHz •Impedance: 8 ohm •Sensitivity: 88dB •Power Handling: 70WRMS
Cat. CW-2106
WAS $99

$79

8" WOOFER RESPONSE

SAVE $15

•Frequency Response: 39-3.5khz •8 ohm •Sensitivity: 90dB •Power: 75WRMS
Cat. CW-2136
WAS $85

$70

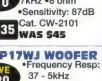
12" CARBON FIBRE WOOFER

•Freq Response: 25-3.5khz •Impedance: 8Ω •Sensitivity: 93dB •Power: 200WRMS
Cat. CW-2145
WAS $229

SAVE $30

$199

5" SCREENED WOOFER

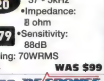


SAVE $10

•Frequency Response: 66 -10khz •Impedance: 8 ohm •Sensitivity: 91dB •Power Handling: 75WRMS
Cat. CW-2102
WAS $49.95

$39.95

6.5" SCREENED CARBON FIBRE WOOFER



•Frequency Response: 38 - 5kHz •Impedance: 8 ohm •Sensitivity: 87dB •Power Handling: 50WRMS
Cat. CW-2107
WAS $78.95

$58.95

SAVE $20

10" WOOFER

SAVE $30

•Frequency Response: 29 – 2.5khz •Impedance: 8 ohm •Sensitivity: 91dB •Power Handling: 160WRMS
Cat. CW-2137 **WAS $129**

$99

D19 SCREENED SOFT DOME TWEETER

•Frequency Response: 3k - 20kHz •8 ohm •Sensitivity: 89.5dB •Power Handling: 100WRMS
Cat. CT-2018
WAS $49.95

SAVE $15

$34.95

ECONOMY 1141 PIEZO TWEETER

SAVE $10

Ideal for amateur PA and low cost speaker projects. Does not require a crossover. •Freq. Response: 2.5k to above 20kHz •Sensitivity: 92dB •Measures: 187 x 79mm •Power Handling: 112WRMS @ 8 ohms •224WRMS @ 4 ohms
Cat. CT-1908 **WAS $22.95**

$12.95

D25AC 25mm METAL DOME TWEETER

SAVE $20

•Frequency Response: 1.5k - 35kHz •6 ohm •Sensitivity: 89dB •Power Handling: 100WRMS
Cat. CT-2020 **WAS $69.95**

$49.95

2" CONE TWEETER

•Frequency Response: 2k - 16kHz •Impedance: 8 ohm •Sensitivity: 91dB •Power Handling: 75WRMS
Cat. CT-2000 **WAS $18**

$12

SAVE $6

1" DOME TWEETER

•Frequency Response: 3k - 20kHz • 8 ohm •Sensitivity: 94dB •Recommended crossover point: 6kHz @ 12dB/Octave •Power Handling: 80-100WRMS Cat. CT-2008
WAS $19.95

$9.95

SAVE $10

DOME TWEETER

•Frequency Response: 1.5k - 20kHz •Impedance: 8 ohm •Sensitivity: 94dB •Power Handling: 200WRMS
Cat. CT-2010 **WAS $26.95**

$16.95

SAVE $10

D19 SOFT DOME TWEETER

•Frequency Response: 3k - 20kHz •Impedance: 8 ohm •Sensitivity: 89dB •Power Handling: 100WRMS
Cat. CT-2019 **WAS $34.95**

$24.95

SAVE $10

1" SCREENED DOME TWEETER

•Freq Resp: 3k-20kHz •Impedance: 8 ohm •Sensitivity: 94dB •Power Handling: 80WRMS
Cat. CT-2006
WAS $20.95

SAVE $10

$10.95

LIGHTING AND PARTY LIGHTING

20W TUBE 12VDC FLUORO LIGHT

NEW

SAVE $10

WAS $59.95

$49.95

This attractive, high quality fluorescent light fitting is supplied with a standard 24 inch 20 watt tube which is protected by a clear acrylic cover. The unit has a retractable carry handle for portable use or it can be wall mounted for fixed installations. Operates from 12VDC & includes on/off switch. 95W x 75H x 680Lmm. 520mA. Cat. ST-3060

2 x 20W TUBE 12VDC FLUORO LIGHT

$59.95

SAVE $20

WAS $79.95

Attractive, high quality fluorescent light fitting accepts 2 standard 24 inch 20 watt tubes, protected by a clear acrylic cover. Designed for fixed installations and operates from 12VDC. Size is 140 (W) x 75 (H) x 830 (L)mm. 1 tube 490mA/2 tubes 980mA. Cat. ST-3062

NEW

COMPACT FLOURO BLACK LIGHTS

15 Watt
2 Volt, equivalent to a 70W standard globe. Cat. SL-3154
WAS $23.95

$19.95

SAVE $4

26 Watt
3V, equivalent to a 120W standard globe. Cat. SL-3156

$26.95

SAVE $6

WAS $32.95

FOG MACHINE

Perfect for your party! Cat. AF-1200

WAS $175 SAVE $36

$139

5 Litres of Fog Juice

Cat. AF-1205

$34.95

SAVE $5

WAS $39.95

LIGHTING STAND

This strong and sturdy lighting stand will extend from 1530mm to 3650mm tall and carry support a weight of up to 20kgs. See cat P251 for details. Cat. CL-2800

BUY THE LIGHTING STAND THIS MONTH AND RECEIVE 3 LIGHT CLAMPS FREE
3 x Cat. SL-2959
Value $26.85

$119

3 WAY LINKABLE LIGHT

This modular lighting system can be set to respond to ambient music levels. Can control up to 6 linkable modules. Extra light modules SL-2952. See catalogue page 250 for details. Cat. SL-2950

$129

Buy the 3 way linkable lights along with 3 extra light modules for $196.50 & receive the 3 extra globes valued at $23.40 Free.

MIRROR BALLS

One of these mirror balls is just what you need to add a bit of life to your next party. Use in conjunction with 1 or more of our Pan36 pinspots for an amazing light effect. See cat. page 250 for details.

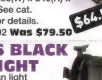
8" Ball - Cat. SL-2980
WAS $24.95
SAVE $5

$19.95

12" Ball - Cat. SL-2982
WAS $43.95
SAVE $7

$36.95

MINI LINKLAMP PARTY LIGHT



This linklamps set is made up of 6 different coloured globes featuring special metal filament bulbs. Complete unit measures 250W x 240(H) x 75(D) mm. See cat. page 252 for details.
Cat. SL-2992 **Was $79.50**

$64.50

SAVE $15

PAR56 BLACK CAN LIGHT

This huge can light features an adjustable mounting bracket and quick change gel-film holder. See cat P251 for details.
Cat. SL-2975
Was $79.95

SAVE $10

$69.95

MINI STROBE LIGHT

This compact 12VDC strobe emits a huge amount of light for its size and features a variable flash rate of up to 10Hz. See catalogue page 250 for details. Cat. SL-2980

WAS $38.95

$32.95

SAVE $6

BUY THE COLOUR MIRROR BALL WITH THE MIRROR BALL MOTOR TOGETHER THIS MONTH AND PAY ONLY $64.95

Any spotlight will do – no need to buy special coloured lights!

12" COLOURED MIRROR BALL

Cat. SL-2981
NORMALLY $55

MAINS MIRROR BALL MOTOR

Cat. SL-2984
NORMALLY $24.95

SAVE $15

8" MIRROR BALL KIT

SAVE $10

This party kit contains everything you need to create your own disco at home. Kit includes 20cm ball, rotating stand, par 36 bulb, and 4 colour filters. Cat. SL-2983

WAS $99

$89

Jaycar will match or better the price of any product our competitors sell, provided the goods are in stock, & of the same quality. Sale Prices included.

VISIT OUR WEBSITE www.jaycar.com.au

MAILORDERS - FREECALL FOR PHONE ORDERS - 1800 022 888

SENSATIONAL KOSS HEADPHONES DEAL

When FORD in the US wanted to include two quality sets of headphones in each of one of their up-market vehicles, they chose KOSS to supply them. We don't have specifications but our experts tested them, and we purchased the lot because they sounded so good. The headphones are lightweight have an adjustable headband and soft foam ear pads. We supply 2 full sets packaged in a complimentary storage case. Sensational value.

Limited quantity available. Made in USA.

Two versions are available

Cat. AA-2046 with 6.5mm plug
Cat. AA-2048 with 3.5mm plug

HURRY SELLING FAST!

$39.95 for two pairs

FANTASTIC CAR SUPER TWEETER DEAL

We have made an amazing scoop purchase of a quantity of Car Super Tweeters. They have a large magnet assembly, on board crossover capacitor and are pre wired for easy connection. These are supplied as pictured, with a foam gasket on the front, (which is easily removed). There is no other mounting hardware supplied, but at the price, who cares!

$7.95ea
10+ $6.50ea
100+ $5.50ea

•System power: 40WRMS •Freq Resp: 6-20KHz
•25mm mylar dome tweeter. Cat CS-2218

PIANO SPEAKERS FROM RESPONSE

These attractive lacquer finished speakers deliver exceptional sound for their modest price. The 10 inch subwoofer comes complete with it's own inbuilt high powered amplifier, while both the centre and satellites are magnetically screened for use around AV equipment such as TVs. See catalogue page 217 for details.

10 INCH POWERED SUBWOOFER

Cat. CS-2454
Was $499 SAVE $50 **$449**

CENTRE SPEAKER

Cat. CS-2450
Was $159 SAVE $20 **$139**

BOOKSHELF SPEAKERS

Cat. CS-2452
Was $229 SAVE $20 **$199**

COMPLETE HOME THEATRE PACKAGE

Buy our complete home theatre speaker system which includes a centre channel, 2 pairs of bookshelf speakers, and the 10 inch powered subwoofer – everything you need for an amazing Digital 5.1, 6 channel system.

Was $999 SAVE A FURTHER $50 **$949**

12" POWERED SUBWOOFER

Finished in an attractive timber veneer, this 12 inch subwoofer drives a bass reflex enclosure and is powered by a 150WRMS inbuilt amplifier. Features active 40- 180Hz crossover, High level inputs, Phase reversal switch, as well as high speaker and line-level inputs. See catalogue page 216 for details.

Cat. CS-2456 **$499**

NEW RESPONSE 500WRMS 5 CHANNEL CAR AMP

SAVE $60 **$499** **Was $559**

This high power five channel car amp employs a separate mosfet switching power supply for the main channels & subwoofer circuit. It is clad with all gold fitting & incorporates an active high or lowpass crossover which is variable from 40 – 120Hz @ 12dB/Octave on both the front and rear main channels. A dedicated parametric EQ, gain, and 12dB/Octave crossover for the subwoofer channel is also featured. See cat P243 for details.

•75WRMS x 4 + 200WRMS x 1 @ 4ohm
•110WRMS x 4 + 320WRMS x 1 @ 2ohm
•220WRMS x 2 (bridged) + 320WRMS x 1 @ 4 + 2 ohm. Cat. AA-0436

Midi Speakers

Ideal For Indoor & Outdoors

NEW

Made from black ABS plastic and are weather resisitant. Rated at 40WRMS and fitted with a metal grill. They boast an excellent 50Hz to 18kHz frequency response and sound surprisingly good.

•40WRMS
•Impedance 4Ω •5" woofer •1" tweeter
•150W x 230H x 150Dmm •2kg each
Cat. CS-2435 PRICED BELOW NORMAL **$169Pr.**

SAMSUNG® DIGITAL VOICE RECORDER

NEW

This incredible digital voice recorder from SAMSUNG® will store up to 810 minutes (Yes! That's 13.5 hours) of voice quality audio in a neat & slim, hand-held unit. 4 separate message groups are available and each group can have up to 100 messages. An integrated LCD shows the status of various functions including battery condition, record playback level, message number & length, message group, etc. The recorder has a VOX function and variable microphone sensitivity for voice operated recording. Software is included to enable messages to be downloaded to a PC and e-mailed to friends or colleagues.

NUGE 13.5 HOUR RECORDING TIME

Cat. XC-0280 **$449.95**

RCA/S-VIDEO AV SWITCHER BOX

SAVE $10

This slimline unit allows you to switch up to 4 devices on only one input to your TV, VCR, etc. Suits both S-Video and RCA cables and even includes a handy headphone jack for personal listening. See catalogue page 225 for details. **Was $44.95** Cat. AC-1664 **$34.95**

350WRMS SUBWOOFER AMPLIFIER MODULE

SAVE $40

This high powered subwoofer amplifier module intergrates a remote mount panel containing gain and crossover controls, as well as a wireless handheld remote control.

•240WRMS @ 8 ohms
•350WRMS @ 4 ohms
•Phase Control
•Auto 'on' and 'off' **WAS $429**
•Variable active crossover: 50 to 160Hz
•THD: <0.1% •Signal to Noise ratio: >95dB
•Bass boost: 5dB @ 35Hz Cat. AA-0508 **$389**

PARTY SPEAKERS

These speakers feature hard wearing black carpet with plastic corner protectors and a tough metal grille to protect them from dancing feet. See cat P216 for full details.

12" Model
Efficiency: 93dB/W Impedance: 8Ω
Power handling: 100WRMS
Box size: 690 x 385 x 350mm
Cat. CS-2512 *2 needed for stereo **$209ea**

15" Model
Efficiency: 94dB/W
Imp: 8 ohms
Power handling: 120WRMS
Box size: 740 x 505 x 350 mm
Cat. CS-2515
*2 needed for stereo **$159ea**

WATCH CABLE TV ALL OVER THE HOUSE

2.4Ghz Audio/Video Sender with IR Remote Control. Cat AR1806

Only $239

CDR's & CD-RW's

	CAT	Buy 1	Buy 10
RIDATA 80MIN AUDIO	XC-4705	$1.65	$14.50
TDK DIGITAL AUDIO	XC-4706	$1.95	$17.50
MITSUI GOLD	XC-4708	$1.65	$14.50
PHILIPS GOLD	XC-4711	$1.95	$17.50
PRINCO 80MIN	XC-4713	$1.65	$14.50
PYROD BLACK 80MIN	XC-4714	$1.65	$14.50
AVALON PLATINUM	XC-4715	$1.20	$10.50
AVALON CD-RW	XC-4720	$2.50	$22.10
10 Pkt PYROD GOLD IN SLEEVES	XC-4717	$9.95	
25 Pkt PYROD BLUE ON CAROUSEL 700MB 80 MIN	XC-4712	$23.95	
50 Pkt PYROD BLUE ON CAROUSEL 700MB 80 MIN	XC-4718	$39.95	

OVERNIGHT DELIVERY

NI-MH RECHARGEABLE BATTERY DEAL

Sub C 2700mAh
Normally $8.95
Nov.$7.95
Buy 10 $6.95ea

Cat. SB-2447

C Size 4500mAh
Normally $14.95
Nov.$12.95
Buy 10 $10.95ea

Cat. SB-2429

8.4V (9V) 200mAh
Normally $14.95
Nov. $12.95
Buy 10 $11.95ea

Cat. SB-2467

D Size 8000mAh

Normally $24.90
Cat. SB-2449

Nov.$21.90
Buy 10 $18.95ea

SAVE

SAVE ON AA & AAA NI-MH RECHARGEABLES

These rechargeable AA sized batteries feature a huge 1500mAh capacity and are ideal for use with products, which have a high current draw such as camcorders, digital cameras, portable disc players, etc. See cat page130 for details.

NIPPLE Cat. SB-2442 NORMALLY $4.30ea
ONLY $3.80ea 10+ $3.25ea SAVE 50c each
WITH TAGS Cat. SB-2443 NORMALLY $4.55ea
ONLY $4.05ea 10+ $3.50ea SAVE 50c each
AAA 650mA NIPPLE Cat. SB-2444
NORMALLY $4.50ea
ONLY $3.95ea 10+ $3.50ea SAVE 55c each
AAA 650mA WITH TAGS Cat. SB-2446
NORMALLY $4.75ea
ONLY $4.20ea 10+ $3.75ea SAVE 55c each

AUTO BATTERY CHARGER

2/6/12V SAVE $10

Was $42.95
This fully automatic lead acid battery charger is suitable for 2, 6, and 12V sealed acid batteries.
•600mA charging current
•Short Circuit Protection
•Wrong Polarity Protection
•Constant Charging Current
•LED status indicator
Cat. MB-3518

$32.95

12VDC/240VAC SMART BATTERY CHARGER

10xAA or AAA Ni-Cd & Ni-MH

This microprocessor-controlled charger will accept a combination of up to 10 'AA' or 'AAA' batteries, and is suitable for both Ni-Cd and Ni-MH type cells. Processor uses delta V sensing to achieve maximum charge while individual LED indicators display charging status. Cat. MB-3512

$69.95

Buy a MB-3512 Smart Charger along with 6 high capacity 1500mAh Ni-MH 'AA' batteries this month in time for Christmas, and we will give you the remaining 4 FREE! SAVING - $15.00

12VDC/240VAC Lithium-Ion Camcorder Battery Quick Charger

This microprocessor controlled charger is designed to quickly charge 3.6 & 7.2 volt Lithium-ion camcorder batteries in as little as 4 hours, (up to twice as fast as an ordinary charger) and keep them topped up between uses. It features precision end-of-charge voltage detection, 'top-off' trickle charge, defective battery detection and over charge protection. Suitable for most lithium-ion camcorder batteries. Adaptors are included to suit batteries from the major manufacturers including Sony®, PANASONIC®,JVC®, CANON®, & SHARP®.
Cat. MB-3585

$79.95

BOOT/HATCH RELEASE

Are you sick and tired of having to use your key to get into the boot all the time? Straight forward to install, this unit simply mounts next to the latch assembly in the bootlid or hatch. See cat. page 178 for details.
Cat. LR-8834

$29.50
SAVE $3

REVERSING & PARKING SENSOR

SAVE $10

$89.95

Was $99.95
This clever little unit will alert you to the presence of obstacles when reversing and parking. No more scuffed or damaged bumpers!
Cat. LR-8864

SAVE ON SEALED LEAD ACID BATTERIES

See catalogue page 131 to 132 for details.

4.2Ah 6V
Cat. SB-2496
70(L) x 47(D) x 107(H)mm
Was $22.50
SAVE $8
$14.50

5Ah 6V LANTERN BATTERY
Cat. SB-2496
67(L) x 67(D) x 97(H)mm
Was $34.95
SAVE $10
$24.95

12Ah 6V
Cat. SB-2497
151(L) x 50(D) x 100(H)mm
Was $36.95
SAVE $10
$26.95

1.3Ah 12V
Cat. SB-2480
97x43(D) x 57(H)mm
Was $27.95
SAVE $8
$19.95

2.2Ah 12V
Cat. SB-2482
$22.95
SAVE $10

4.2Ah 12V
Cat. SB-2484
90(L) x 70(D) x 106(H)mm
Was $39.50
SAVE $11
$28.50

7.2Ah 12V
Cat. SB-2486
151(L) x 65(D) x 101(H)mm
WAS $44.95
SAVE $15
$29.95

18Ah 12V
Cat. SB-2490
181(L) x 76(D) x 167(H)mm
Was $88.95
SAVE $19
$69.95

DURATECH 240V SOLDERING IRONS

25 WATT
Cat. TS-1465
Was $19.80
SAVE $7
$12.80

40 WATT
Cat. TS-1475
Was $27.95
SAVE $10
$17.95

20TH BIRTHDAY SALE

DURATECH TEMPERATURE CONTROLLED SOLDERING STATION

$179

This professional grade temperature controlled soldering station is a must for the hobbyist or technician who relies on a durable and easy to use iron for the assembly bench or workshop. Cat. TS-1380

Buy this month and receive a 200g roll of solder*, PCB/Job Holder (Cat TH-1982) and Solder Heatsink/Component Holder FREE – Saving Value $24.95
*Cat. NS-3010 - 1.00mm dia.

PRICES SLASHED AGAIN ON DATA STORAGE MEDIA!

MEMORY CARDS

Perfect for digital cameras PDA's, PC's, MP3 players etc!

CompactFlash™

Rewritable, non-volatile storage. Fully compatible with CFA & PC Card ATA standard. •36.4x42.8x3.3mm

	CAT	Now	SAVE
16mB	XC4771	$99.95	$66.95	$33.00
32mB	XC4772	$165	$89.95	$75.05
64mB	XC4773	$295	$153.95	$141.05
128mB	XC4774	$409	$265.95	$143.05

Smartmedia™

Rewritable, non-volatile storage medium for high capacity portable devices such as Digital Cameras, PDAs, MP3 players etc. Fully compatible with PCMCIA release 2.1. •45 x 37x 0.76mm

	CAT	Now	SAVE
16mB	XC-4775	$99.95	$41.95	$58.00
32mB	XC-4776	$165	$73.95	$91.05
64mB	XC-4777	$295	$141.95	$153.05

See cat page 156 for our range of memory cards, adaptors and readers

Compactflash Smartmedia

JAYCAR CD-ROM CATALOGUE

- Over 4,700 Products
- Printable Order Form
- Direct Email Ordering
- Comprehensive Search Facility

Cat. BJ-5005
$2.50

OVERNIGHT DELIVERY

MAILORDERS - FREECALL FOR PHONE ORDERS - 1800 022 888

ULTRASONIC DIMENSION PRO

This product provides an instantaneous and easy means of measuring room dimensions up to 12.5 metres. Measuring point is marked by red laser dot. Ideal for painters and renovators to produce a rough quotation in seconds. See cat P264 for details.
Cat. QM-1620
Was $69.95
$49.95
SAVE $20

AC/DC CLAMP METER

SAVE $20
$139
Similar to our 1000A clampmeter, this intelligent clamp meter can measure both volts and amps via the transformer 'clamp'. Also features capacitance, frequency, continuity busser, and more. See cat. pagE 32 for details.
• 600V AC/DC • 200A AC/DC
Cat. QM-1562 **Was $159**

1000A AC/DC CLAMP METER

SAVE $50
Ideal for all industrial electricians, this quality clamp meter provides a quick, safe, and simple way of checking high current flow across busbars, power cable, etc. Supplied in quality carry case. See catalogue page 32 for details.
•1000VDC •750VAC
•1000A DC •1000A AC
•0 – 30M
•0 – 30Khz **$179**
Cat. QM-1560 **Was $229**

3 – 15VDC 40A SWITCHMODE POWER SUPPLY

This high current variable-voltage power supply is ideal for testing and/or powering low voltage equipment such as car amplifiers, radio equipment, lighting, etc. Power output is via twin banana sockets that can accept both banana plugs and/or bare wires. Cat. MP-3090
$369 SAVE $30 **Was $399**

LIQUID ELECTRICAL TAPE

This stuff is a must have for the hobbyist or electrician. Simply brush on to insulate and seal out moisture from cables, connections, PCB mount components, etc. Acid and salt resistant and wont crack or peel. Supplied in 118mL can with brush. See catalogue page 86 for details.
Black Cat. NM-2832 **Was $29.95** SAVE $5 **$22.95**
Red Cat. NM-2834

AUTOMATIC CENTRE PUNCH

PRICK PUNCH
$6.95
This handy tool allows you to make a centre punch mark with one hand. Sturdy brass body with hardened steel centre punch.125 mm long overall. See catalogue page 53 for details. Cat. TH-1770

High Quality 5.5" Electrical Shears with Pouch

NEW
These shears offer impressive cutting ability with finely honed and serrated blades. Great for cutting insulation, heatshrink, spaghetti and light hook-up wire. The shears feature insulated handles and are supplied with a heavy duty nylon belt pouch. Cat. TH-1756
$27.95

Super Bright Three LED "White" Torch

NEW
This headlight torch is fantastic! It weighs just 62g (with batteries) and uses 3 ultra-bright LEDs to give an amazing amount of bright, nicely diffused white light. LEDs require much less power than ordinary globless and will run for ages on the 3 x AAA batts (inc). Cat. No. ST-3058
1 LED VERSION Cat. ST-3057 Only $19.95
Only $29.95

IEC Right Angle Power Lead

NEW
Perfect for that tight spot behind a piece of equipment. IEC plug is right angle, cable length is 2mt and there is a standard mains plug on the other end. Cable colour is black. Cat. PS-4107
$9.95

LAMINATORS

These quality laminators are perfect for domestic use, and are ideal for protecting photos, documents, or certificates. Two models available. Suits business cards/photographs
Cat. XL-2502 **$59.95**
Suits A4 sized sheets
Cat. XL-2508 **$179**

Laminating Sleeves

Pkt 100 business card sleeves
95 x 57mm Cat. XL-2504 **$7.50**
Pkt 24 Photo sleeves
156 x 112mm Cat. XL-2505 **$7.95**
Pkt 25 A4 sleeves
303 x 216mm Cat. XL-2512 **$13.95**

ROPELIGHT FOR XMAS

8 mtrs long, 240V mains, with controller provides 8 different patterns.

Red	SL-2821
Green	SL-2822
Light Blue	SL-2823
Yellow	SL-2824
Clear	SL-2825

2000 Price $69.95 ea
2001 Price $59.95 ea
Birthday Price $49.95ea

4" UV BLACKLIGHT GLOW STICK

Dazzle your friends with this UV glow stick. Simply snap and shake to produce bright UV light output.
NEW
Cat. ST-3175
$4.95
Light sticks are great for dance parties & nightclubs and create fascinating patterns if held while dancing.

KEYRING LASER POINTER

SAVE $3
$9.95
WAS $12.95
This handy little laser is great fun and makes an excellent novelty or gift. See catalogue page 267 for details.
Cat. ST-3102 SAFE! 1mW output

INFRARED-TRIGGERED STOPWATCH

SAVE $10
$39.95
Was $49.95
The versatile kit uses a digital stopwatch module and an infrared transmitter and receiver to produce an accurate lap timer or general purpose IR activated stopwatch. Can be started with a button and stopped with the IR trigger, or vice-versa. See catalogue page 19 for details.
Cat. KG-9184

ADDITIONAL IR TRIGGER KIT

SAVE $10
$19.95
Cat. KG-9186 **Was $29.95**

MULTIMETERS

BACKLIT DMM

•Data Hold
•Continuity Buzzer
•Transistor tester
•3.5 Digit
•10A current
•Low battery indication **$18.95**
•Holster SAVE $8
Included **WAS $26.95**
See catalogue page 26 for details. Cat. QM-1522

FREQUENCY DMM

•Extra large display
•Temperature
•Frequency SAVE $15
•Capacitance
•Auto power off
•Diode tester
•Transistor tester
•Holster included **$54.95**
WAS $69.95
Cat. QM-1320
See catalogue page 28 for details.

PC INTERFACE DMM

WAS $129.95
•PC interface
•Temperature
•Transistor tester
•Auto Ranging
•Capacitance SAVE $30
•Diode tester
•Backlight **$99.95**
•Holster included
•Carry Case included
See cat P30 for more.
Cat. QM1350

AUTO RANGING DMM

•Probe Lockout Shutters •Slow Decay Backlight
•Auto Ranging •Capacitance •Frequency
•38 segment •Bargraph SAVE $20
•3999 count •Clamp meter Range **$79.95**
•Continuity Buzzer •Holster included
•Low Battery indicator Cat. QM-1532 **WAS $99.95**

4 IN 1 DMM

•SPL meter SAVE $20
•Lux meter
•Humidity meter **$89**
•Temperature meter **WAS $109**
•Transistor tester
•Continuity tester
•Holster included
See cat. page 30 for details.
Cat. QM-1580

DOUBLE INSULATED AUTO RANGING DMM

•3.75 digit display SAVE $20
•Data Hold **$69.95**
•Slow decay backlight
•Frequency
•Auto power off
•Diode tester **WAS $89.95**
•3999 count
•Capacitance
•Relative Measurement
•Low battery indicator
•Duty Cycle Measurement **$69.95**
•Holster included Cat. QM-1540
See catalogue page 29 for details.

ANALOGUE - 10 AMP

•10 Amp AC/DC
•Mirrored meter
•Continuity buzzer •Diode tester •20000 ohm •Fused and Diode protected SAVE $8
See cat P31 for details. **$24.95**
Cat. QM-1020
WAS $32.95

MAILORDERS - FREECALL FOR PHONE ORDERS - 1800 022 888

OVERNIGHT DELIVERY

OVERNIGHT DELIVERY

PAN/TILT B&W SPEED DOME CAMERA WITH AUDIO

$489 SAVE $60

This speed dome camera uses a black and white CCD sensor with a 92 degree viewing angle, along with two servo motors which allow the camera to pan of 355°, and tilt up to 80°. Requires Cat. QC-3200 to operate. See catalogue page 195 for details. Cat. QC-3210 **WAS $549**

PAN/TILT COLOUR SPEED DOME CAMERA WITH AUDIO WAS $799

$739 SAVE $60

Similar to it's B&W brother, this speed dome camera uses a colour CCD sensor with a 92 degree viewing angle, along with two servo motors which allow the camera to pan of 355°, and tilt up to 80°. Requires QC3200 to operate. See catalogue page 195 for details. Cat. QC-3215

4 CHANNEL SPEED DOME PAN/TILT CONTROLLER

$179 SAVE $70

This 4-channel switcher can control and interface up to four of our speed dome cameras. Supplied complete with full feature remote control, and mains plug pack. See catalogue page 195 for details. Cat. QC-3200 **WAS $249**

SUPER SURVEILLANCE DEAL

This kit contains everything you need to set up a comprehensive CCTV surveillance system for the home, office or workplace. System includes:

$999 SAVE $218

4 x QC3472	B&W Dome Camera
1 x QM3402	10" B&W monitor (no audio)
1 x QC3361	4-way B&W processor
1 x MP3033	Power Supply
3 x WQ7280	DC-plug Y-Adaptor
2 x WQ7277	15M Camera Lead
2 x WQ7278	20M Camera Lead
1 x WV7300	BNC to BNC Lead

Cat. AA-0148 **Was $1,217**

DEAL

Buy our Time Lapse VCR (Cat QV-3050) at the same time, & we'll reduce the price by $100! From $950 to $850.

PANNING SURVEILLANCE CAMERA BASE

This panning camera base uses a servo motor to provide up to 355° of surveillance coverage. Unit can also be manually tilted through 90° and will accept a wide range of cameras. Requires QC3202 to operate. See catalogue page 195 for details. Cat. QC-3206 **WAS $195**

SAVE $20 $179

PAN/TILT SURVEILLANCE CAMERA BASE

SAVE $50

This camera base uses 2 servo motors to provide both pan and tilt functions. Unit will pan through 355°, and tilt through 60°. Unit accepts a wide range of cameras. See catalogue page 195 for details. Cat. QC-3204 **WAS $499**

$449

PAN/TILT SCANNER CONTROLLER

WAS $99 SAVE $10

This controller is designed for controlling our panning, and pan/tilt surveillance camera mounts. Features a handy scanning function for automatic operation. See catalogue page 195 for details. Cat. QC-3202

$89

WIRELESS DOORBELL WITH STROBE LIGHT

This doorbell integrates an audible 'ding/dong' type doorbell as well as a strobe light for visual indication. The versatile system allows you to use a single doorbell with multiple receivers, or multiple doorbells with only one receiver. Features extended range. See cat. page 269 for details.

RECEIVER Cat. LA-5015 **WAS $59.95**

SAVE $10 $49.95

DOORBELL Cat. LA-5016 **WAS $24.95**

SAVE $6 $18.95

DIGITAL VOICE RECORDER

This digital voice recorder will record multiple recording with a total recording time of 20 seconds. Messages are played back sequentially and individual messages can be deleted. See catalogue page 266 for details. Cat. XC-0276 **WAS $21.95**

SAVE $5 $16.95

AUDIO/VIDEO CATS BALUN

SAVE $10

This product allows you to transmit both video and audio signals from a CCD camera, or VCR / CD / DVD player through low-cost Cat5 or Cat5e cable over much longer distances than are possible with standard co-axial cable (2 required). See catalogue page 200 for details. Cat. QC-3424 **WAS $95**

$85

$1 COIN CCD CAMERA

SAVE $20

This CCD camera features audio and 1mm pinhole lens and audio housed in a compact metal case that measures a tiny 25mm2. See cat. page 192 for details. Cat. QC-3473 **WAS $179**

$159

AMAZING TECHNOLOGY BREAKTHROUGH

EXCLUSIVE TO JAYCAR Day/Night Colour CCD Camera with Sony® Sensor, I/R Capability, Auto-iris Controller & Audio NEW

This camera can operate in 0 Lux lighting conditions when used with our optional infrared illumination lenses. The camera automatically detects I/R illumination & adjusts itself for optimum picture quality. Cat. QC-3321

$379

CCTV Lenses with Infrared Illumination (For QC-3321)

$119ea

- Power 12VDC @ 160mA
- Illumination range: 10 metres
- Focus range: 40cm to infinity

3 Versions Available

4mm Lens Cat. QC-3322
6mm Lens Cat. QC-3323
8mm Lens Cat. QC-3324

INFRARED LIGHT FOR CCD CAMERAS WAS $42.95

SAVE $10

Compact module allows your CCD camera to 'see in the dark'. A bank of 28 infrared LEDs considerably increase the night-vision of a CCD camera. See cat. P192 for details. Cat. AA-0290

$32.95

DUMMY VIDEO SURVEILLANCE CAMERA

SAVE $7

This dummy surveillance camera features a flashing status indicator which runs for ages on a single 'C' size battery. Supplied in metal case. Measures 60 x 55 x 190mm. See catalogue page 176 for details. Cat. LA-5316 **WAS $39.95**

$32.95

PERSONAL ALARM

SAVE $2

Simply pull the pin and the alarm emits an ear piercing 130dB shriek that is almost unbearable. See catalogue page 176 for details. Cat. LA-5180 **WAS $11.95**

$9.95

CMOS COLOUR PINHOLE CAMERA WITH AUDIO NEW

Our smallest colour video camera yet! Measures just 20 x 20 x 16mm.

$159.95

Composite video output can be connected directly to a video recorder or the A/V input of a normal TV. Requires 9VDC at 100mA. Use our MP-3130 regulated adaptor. •Supplied leads: 25cm, 2.1mm DC, RCA video & audio •Resolution: 380TV lines •Min Lux: 4 •View angle: 70° Cat. QC-3459

AVGAD HOME ALARM SYSTEM WITH DIALLER

THE ULTIMATE IN HOME SECURITY

AVGAD

This comprehensive alarm system features an inbuilt dialler that can be programmed to call your work phone, mobile phone and/or a security monitoring company. Available in both 5 and 8 sector models.

5 SECTOR PACKAGE $675
Cat. LA-5484

SAVE $54

System Includes:
- 5 sector alarm panel • Keypad
- 3 AV-Gad PIRs • 7Ah Back-up battery
- Strobe light • Horn Speaker
- 4 Warning Stickers • 2 Reed Switches
- ABS Siren cover • Internal Siren
- 30metres of 2 core cable
- 100metres of 6 core cable **Was $729**

8 SECTOR PACKAGE
Cat. LA-5485 **Was $939**
System is the same as LA-5484 but has: • 8 sector alarm panel

SAVE $90 $849

EMAIL YOUR ORDERS TO mailorders@jaycar.com.au

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MAILORDERS - FREECALL FOR PHONE ORDERS - 1800 022 888

OVERNIGHT DELIVERY

LOW VOLTAGE GARDEN LIGHTING SYSTEM

These garden lights run on 12VDC and are supplied on a continuous 100-metre roll – you simply purchase the exact length you require! Ideal for outdoor entertaining where casual lighting is desired. 3 bulbs per metre.
See cat. page 257 for details.
Cat. SL-2810 **Was $2.20M**

SAVE $0.45

$1.75m

AM/FM FM RECEIVER WITH PLL

This compact digital FM receiver is capable of picking up both AM and FM radio, as well as aircraft band. Features Phase Lock Loop circuitry to maintain absolute frequency stability. See catalogue page 269 for details.
Was $89.95 Cat. AR-1795

SAVE $20

$68.95

GIANT WALL DATA CHART

This giant wall poster contains technical data and/or pin-outs diagrams on just about every electonic orientated product such as all types of Semi-conductors, capacitors, heatsinks, wire, connectors, etc.
See cat. page 294 for details.

SAVE $2

$5.95

Was $7.95
Cat. BC-6005

4 CHANNEL CCTV PROCESSORS

CONTACT US FOR FULL DETAILS.

B&W Cat. QC-3359 $349

COLOUR Cat. QC-3363 $495

COLOUR Cat. QC-3362 Includes: time & date stamp $599

12VDC 300mA REGULATED POWER SUPPLY

This compact 12VDC 300mA power supply features a regulated output making it ideal for powering most CCD cameras. Suitable for all our cameras. See catalogue page 192 for details. Cat. MP-3011 **WAS $24.95**

SAVE $6

$18.95

HIGH CAPACITY RECHARGEABLE SPOTLIGHT

This hand held spotlight uses a 6V sealed lead acid battery and a high brightness Krypton bulb. Ideal for use while camping. Includes mains charger. See cat. page 258 for details.
Cat. ST-3082 **WAS $39.95**

$29.95

SAVE $10

WATERPROOF CAMPING LANTERN

Suitable for all manner of outdoor activities this lantern is fully waterproof and will even float if dropped in water by accident.
Measures 130 x 190mm
See cat. page 259 for details.
Cat. ST-3035 **WAS $27.95**

$22.95

SAVE $5

oziFOX Sellout 5Mhz Storage CRO Pen

Limited Qty Available.

This remarkably tiny handheld CRO puts the functions of a 5Mhz iscilloscope and a digital voltmeter in the palm of your hand. Features a 16 x 64 pixel LCD display for viewing wave forms and voltage readings and can be interfaced with a PC to display the information on the computer monitor for further analysis. See cat page 33 for details.
Was $279 Cat. QC-1907

$249

SAVE $30

16 CHANNEL FULL DUPLEX SURVEILLANCE MULTIPLEXER

SAVE $1000

This professional unit is designed to manage surveillance of up to 16 separate locations simultaneously. Ideal for medium to large sized offices and shops. The multiplexer features both a VCR and monitor output along with an RS232 interface for covert operation. See catalogue page 196 for details.
Cat. QC-3365 **Was $2,799**

$1,799

MINI WATERPROOF CAMPING LANTERN

Similar in design to it's big brother, this waterproof camping lantern uses a high brightness Krypton bulb and 4 'AA' batteries to provide 360° light coverage. Measures only 90 x 160mm.
See catalogue page 259 for details.
Cat. ST-3033 **WAS $16.95**

SAVE $3

$13.95

INDOOR TELEVISION POWERED ANTENNA

$54.95

SAVE $10

Was $64.95
This TV antenna features an in-built signal amplifier that has a 24dB gain circuit on VHF, and a 20dB gain circuit with attenuator on UHF.
See cat. page 187 for details. Cat. LT-3135

SAVE ON SPEAKER CABLE

Light Duty Speaker Cable 30m Roll
14/0.14mm Figure 8. Grey with black trace.
ROLL LENGTH 30M
Cat. WB-1703 **WAS $10.95**

SAVE $3

$7.95

Heavy Duty Speaker Cable 30m Roll
24/0.20mm Figure 8 with trace.
ROLL LENGTH 30M
Cat. WB-1709 **WAS $19.95**

SAVE $3

$16.95

Extra Heavy Duty Fig 8 30m Roll
2 x 79/0.2mm.
ROLL LENGTH 30M
Cat. WB-1713 **WAS $59.95**

SAVE $12

$47.95

Monitor OFC Speaker Cable 20m Roll
ROLL LENGTH 20 METRES
Cat. WB-1735 **WAS $69.95**

SAVE $20

$89.95

PowerTechPlus SAVE $$$ ON SWITCHMODE PLUG PACKS

Switchable Voltage Switchmode 9, 12, 15VDC @ 1.5 Amp and 18, 20VDC @ 1.2 Amp & 24VDC @ 1 Amp
Cat. MP- 3420 **WAS $49.95**

SAVE $10

$39.95

3, 4.5, 5, 6, 6.5VDC 2.5A & 7VDC 1.9 Amp Switchmode Switchable
Cat. MP- 3131 **WAS $42.95**

SAVE $10

$32.95

AURA INTERACTOR BACKPACK & CUSHION

20TH BIRTHDAY SALE

CRAZY PRICES

This is by far the best, and now most cost effective way of adding a new dimension to your home computer, video gaming console, or TV.

Backpack

Cat. XC-1000

Some of the cartons are slightly scuffed, but the contents inside are perfect!

$19.95

Cushion

Cat. XC-1005

$29.95

KITS INCLUDE:

Cable Set Cat XC-1001	$9.95
15W Amplifier Cat. XC-1006	$5.00
Shaker Actuator* Cat. XC-1008	$24.95
Power Supply Cat. MP-3055	$24.95
Total Value	$64.85

*Installed inside both the Backpack & Cushion

POWER SUPPLY BARGAINS

Output plugs 2.5mm DC

12VDC 2 AMP
Cat. MP-3210 **WAS $36.95**

SAVE $14

$22.95

13.5VDC 1.8 AMP
Cat. MP-3212 **WAS $36.95**

SAVE $14

$22.95

OVERNIGHT DELIVERY

JAYCAR KITS

Low-Cost AV Distribution Amp Kit for Composite Video

Jaycar Exclusive - Silicon Chip Nov 2001

NEW

Split your audio and composite video signal up to six ways without any loss in quality. Great during presentations where multiple monitors are required or for a small video duplication facility. It handles any mono or stereo audio signals and builds nicely into a slimline case. Kit supplied with PCB, case, silk-screened & punched panels and all electronic components. 12VDC (60mA) power required – use plugpack MP-3002.

Cat. KC-5320

$139.95

Low-Cost AV Distribution Amplifier Kit for S-Video

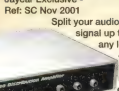
Jaycar Exclusive -

Ref: SC Nov 2001

NEW

Split your audio and S-video signal up to three ways without any loss in quality. Great during presentations where multiple monitors are required or for a small video duplication facility. It handles any mono or stereo audio signals and builds nicely into a slimline case. Kit supplied with PCB, case, silk-screened & punched panels and all electronic components. 12VDC (60mA) power required – use plugpack MP-3002.

Cat. KC-5321



$139.95

NEON TUBE SOUND DISPLAY KIT

Silicon Chip November 2001

Following the tremendous success of the original 1997 Sound Mod kit, this latest version overcomes some of the original's limitations. With this latest kit you can now use any output from your car stereo – it is not limited to being exclusively driven by a subwoofer output, unlike it's predecessor. This kit drives any colour neon tube in the Jaycar range (see website) and has the option of turning the tube either on or off to the beat of the music. Kit supplied with PCB, silk-screened case plus all specified electronic components.

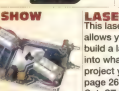
Cat. KC-5322

$23.95

LASER LIGHT SHOW

This awesome kit will turn a regular laser into a dazzling laser display. Create various shapes and designs on a wall, floor, or projector. Perfect for parties. Requires laser module (ST3115) to operate. See cat. page 14 for details.

Cat. KG-9098 **WAS $39.95**



$33.95

SAVE $6

LASER TO SUIT KG-9098

This laser module allows you to build a laser into whatever project you desire. See catalogue page 267 for details.

Cat. ST-3115

$13.95

CFL – FLUORESCENT LAMP DRIVER

Refer SC July '00.

Cat. KC-5293 **WAS $69.95**

SAVE $20

$49.95

EXPERIMENTER'S KITS

2 Kits in 1 - Motor/Light

Learn the basics of electronic circuits and the fundamentals of electric motors and lighting circuits. All components are supplied for assembly onto a neat panel using spring clips. Even the electric motor itself is supplied in knock down form and requires assembly.

Cat. KJ-7042 **WAS $19.95**

$14.95

SAVE $5

32 Bi-Coloured LED CHRISTMAS TREE LIGHT

$59.95

BUILD NOW IN TIME FOR CHRISTMAS!

This ever-changing light display is perfect for the top of the Christmas tree this year. This microprocessor-based project generates several different patterns on 32 Bi-coloured LEDs, pulsing them between red, green and orange. See catalogue page 19 for details.

Cat. KC-5280

RUNNING LED DISPLAY KIT

SAVE $20

Build and program you own running light display. Perfect for spreading Christmas cheer. Display See catalogue page 19 for details.

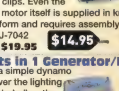
Cat. KJ-8720 **WAS $179**

$159

2 Kits in 1 - Generator/Light

Build a simple dynamo to power the lighting kit (included) or the other kits in the range. Includes simple gearbox and mounts into its own plastic chassis.

Cat. KJ-7044



$14.95

WAS $19.95

SAVE $5

SWIMMING POOL ALARM

Refer SC Sept. '00

Cat. KC-5298 **WAS $42.95**

SAVE $7

$35.95

DYNAMIC 3D LED STAR

BUILD NOW IN TIME FOR CHRISTMAS!

This micro-processor controlled array of 30 LEDs creates a number of different eye catching patterns. See cat. page 19 for details.

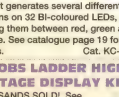
Cat. KC-5253

$32.95

JACOBS LADDER HIGH VOLTAGE DISPLAY KIT

THOUSANDS SOLD! See, hear, & smell raw electricity with this high voltage display. Ignition coil required. See cat.page 13.

Cat. KC-5191 **WAS $34.95**



$29.95

THERAMIN SYNTHESISER KIT

Refer SC August '00. See cat. page 13 for details.

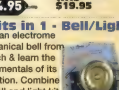
Cat. KC-5295 **WAS $44.95**

SAVE $5

$39.95

2 Kits in 1 - Bell/Light

Build an electrome mechanical bell from scratch & learn the fundamentals of its operation. Combine the bell and light kit together & develop knowledge of the use of light and sound. Cat. KJ-7040



$14.95

WAS $19.95

SAVE $5

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WHOLESALE EMAIL: wholesale@jaycar.com.au

Jaycar ELECTRONICS

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FAX: (02) 9741 8500

Quality Endorsed Company ISO9002 LS 6143 Standards Australia

WHOLESALE
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ORDERS: 1300 738 555
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MELB: (03) 9574 0299

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GOLD COAST • 2/474 Gold Coast Hwy, Mermaid Beach. • Ph:(07) 5526 6722 • Fax:(07) 5526 6733 • Mon/Fri:9-5.30 • Thurs:9-8.30 • Sat:9-4
QLD
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03-01

Low-Cost Audio/Video Distribution Amplifier

Do you need to distribute video and audio signals to a bunch of monitors or VCRs, without any loss in quality? This easy-to-build Audio/Video Distribution Amplifier can split normal composite video (plus stereo audio) signals six ways, or you can use it to split S-video signals three ways.

By JIM ROWE

THERE ARE LOT'S of situations where an AV Distribution Amplifier is necessary. For example, let's say that you want to set up an audio-video (AV) system for a college classroom, where half-a-dozen monitors are to be fed with video and audio signals from a single VCR. Or perhaps you want to set up a small video duplication facility, with a "master" VCR or VCD (video CD) player feeding up to five recording VCRs plus a video monitor (so that you can keep an eye on recording quality).

Another possibility is that you want to set up a stand at a trade show, with the output from a DVD player fed to a video projector, three or four monitors and a sound system.

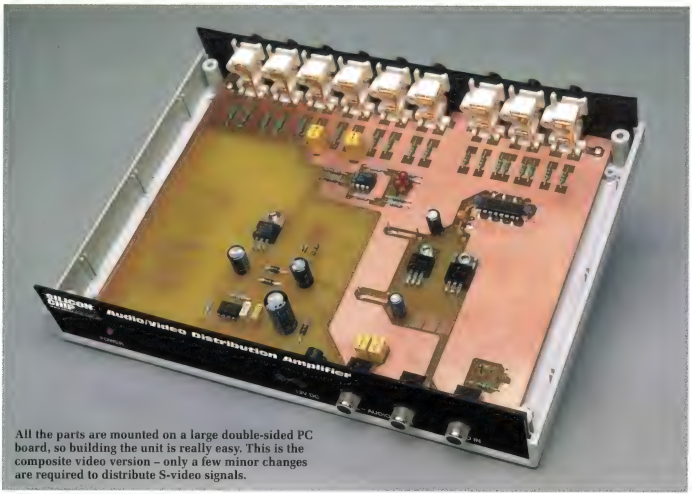
In situations like these, there's more to it than just hooking everything up with the necessary cables and some multi-way connectors. Distributing video and audio signals to multiple destinations has to be done properly, or signal losses and corruption can make the results very disappointing. Blurred pictures with "ringing" and colour "bleed", together with weak and muffled sound, are inevitable unless the system is properly set up.

In general, the way to prevent these problems is to use an "audio-video distribution amplifier". This provides enough gain (or amplification) to compensate for the losses involved in "splitting" the video and audio signals to feed multiple loads. It also ensures that the video cables can all be terminated in the right impedance, to prevent ringing and other distortion.

Commercial AV distribution amplifiers are available but they're not exactly cheap. That's why you might like to consider this design. The kit costs less than half as much as a comparable commercial unit.

What it does

Our AV Distribution Amplifier accepts a standard composite video



All the parts are mounted on a large double-sided PC board, so building the unit is really easy. This is the composite video version – only a few minor changes are required to distribute S-video signals.

signal (PAL or NTSC) from a VCR, camcorder, VCD or DVD player and provides six "clone" signals to drive the same number of monitors, projectors, VCRs or whatever. The video output signals are all virtually identical to the input signal, because the video amplifier stages inside the unit have a frequency response flat to within 0.1dB to over 100MHz.

They also operate with very low distortion, noise and phase shift.

Any line-level mono or stereo audio signals which accompany the video can also be split six ways, again without any significant reduction in frequency response or signal-to-noise ratio. The audio stages also operate with very low distortion and channel crosstalk.

What's more, the unit is very easy to build. It's built inside a standard low-profile plastic instrument case, with all parts mounted directly on a PC board so there's no off-board wiring to worry about. And it all runs from a nominal 12V DC supply, which can be either a low-cost plugpack supply or a battery. The total current drain is less than 60mA.

By the way, although the video side of the unit is mainly intended for distributing normal composite video to six loads, the circuit and PC board pattern also allow it to be wired to distribute S-video or "Y/C" signals to three loads, instead. So if you need an S-video distribution amplifier, we'll explain how this can be done later in the article.

Amplifier chip

The video side of the project is based on a very impressive wideband buffer amplifier chip made by Maxim Integrated Products. Designated the MAX-497, it includes four closed-loop buffer amplifiers, each with a voltage gain of 2.0 and the kind of performance we could only dream about a few years ago.

As you can see from Fig.1, its buffers have a rated frequency response for small signals of about 120MHz (-0.1dB) and the response is still rated to extend to around 215MHz (-3dB) at full power output.

Each buffer amplifier inside the MAX497 offers a typical input impedance of 1MΩ shunted by 2pF, an output impedance of only 1.5Ω at 10MHz, an output slew rate of better than

Where To Buy The Kit

The copyright on this project is owned by Jaycar Electronics who will have complete kits available shortly after publication. These kits will include pre-punched front and rear panels with screened lettering. Prices are as follows:

(1) Complete kit for composite video version $139.95

(2) Complete kit for S-video version $139.95

Kits can be purchased from you nearest Jaycar store or via mail order.

Parts List

1 PC board, code 02111011, 198 x 158mm
1 plastic instrument case, 225 x 165 x 40mm
3 RCA sockets, PC-mounting
9 dual RCA sockets, vertical PC-mount
1 2.5mm PC-mount DC power connector (J22)
8 PC board terminal pins, 1mm diameter
3 10mm x M3 machine screws with M3 nuts
15 small self-tapping screws, 6mm-long

Semiconductors

1 MAX497 quad video amp (IC1)
1 LM833 dual low-noise audio amplifier (IC2)
1 LM555 timer (IC3)
1 7809 +9V regulator (REG1)
1 7805 +5V regulator (REG2)
1 7905 -5V regulator (REG3)
1 3mm red LED (LED1)
1 zener diode, 9V 400mW (ZD1)
3 1N4001 diodes (D1-D3)

Capacitors

1 1000µF 25VW RB electrolytic
2 220µF 25VW RB electrolytic
2 100µF 16VW RB electrolytic
2 10µF 16VW TAG tantalum
2 2.2µF 16VW TAG tantalum
2 0.39µF MKT polyester
2 0.22µF MKT polyester
4 0.1µF monolithic ceramic
1 0.1µF MKT polyester
1 0.01µF MKT polyester

Resistors (0.25W, 1%)

4 100kΩ	4 150Ω
14 47kΩ	5 75Ω
1 10kΩ	1 22Ω
1 2.2kΩ	2 10Ω

Changes for S-video version

6 dual RCA sockets, PC board mounting (not 9)
2 single RCA sockets, PC board mounting (not 3)
4 4-pin mini DIN sockets
9 additional 1mm PC board terminal pins
6 75Ω resistors (not 5)
8 additional 10mm x M3 machine screws with M3 nuts

WHERE TO BUY A KIT

Kits for this project will be available from Jaycar Electronics – see panel.

1100V/µs for a 4V step and an output THD (total harmonic distortion) of better than -58dBc for a 2Vp-p output swing at 10MHz. The overall device also offers adjacent-channel crosstalk of better than -72dB, "all hostile" crosstalk of better than -65dB, and differential gain/phase errors of less than .01%. So it's a very impressive device.

But why a gain of 2.0? Simply because the MAX497 is designed specifically for driving "back terminated" coaxial cables – where the source end of the cable is presented with its matching impedance as well as the load end. This is done by using a series resistor, normally 75Ω for driving video cables.

However this means that a 2:1 voltage divider is formed by the back termination resistor and the cable's termination resistor at the load end. So by giving the buffer amplifier a gain of 2.0, we restore the overall gain to unity and ensure that each load receives a full-amplitude replica of the input signal.

Circuit details

As shown on Fig.2, a single MAX497 (IC1) forms the heart of the distribution amplifier's video circuitry. To use the chip's four internal amplifiers to provide six output channels, we pull a small trick. This relies on the fact that each of the four channels in the MAX497 can actually drive a total load as small as 100Ω (ie, a back-terminated 50Ω cable and load), rather than the 150Ω presented by a back-terminated 75Ω cable and load.

The inputs of all the amplifiers are tied together, so that they produce exactly the same output signal. Then as well as using each output to drive its own specific load via a 75Ω back-termination resistor, we also use each output to provide half the drive to a third output, via 150Ω resistors. This means that the third output from each pair is still driven with an identical signal to the other two and with the same effective back termination resistance (150Ω/2 = 75Ω).

Thus, when the inputs of the two pairs are also tied together, this provides a total of six buffered outputs from a single composite video input.

By separating the two pairs we're also able to use them for handling the separate Y (luminance) and C (chrominance) signals of S-video and split each of them three ways. That's how

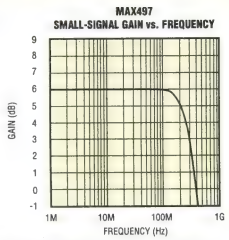


Fig.1: the gain of each amplifier in the MAX497 chip is 2.0 (6dB), and remains virtually ruler flat until beyond 100MHz!

the video side of the unit is changed from 1:6 distribution for composite video to 1:3 distribution for S-video.

The audio side is just as straightforward as the video side, being based on a single LM833 low-noise dual op amp IC (IC2). The two op amps in IC2 are used in identical circuits, one for each of the stereo audio channels.

Each op amp is configured as a buffer, with the 100kΩ resistor pairs applying negative feedback to give a voltage gain of (you guessed it) 2.0. This allows their inputs to be provided with the usual "line level" terminating impedance of 47kΩ and their outputs to be connected to splitter resistors of the same value – so that the overall gain is unity when the outputs are connected to audio equipment inputs with an impedance of 47kΩ.

In this case coupling resistors are used to protect both the inputs and outputs of the op amps from any possible DC levels, but the capacitor values are chosen to minimise any change in frequency response.

Power supply

That's really all there is to it in terms of the distribution amplifiers. The rest of the circuitry is for the unit's power supply, to provide the correct supply voltages which are derived from a nominal 12V DC source.

The MAX497 operates from supply rails of ±5V, while the LM833 needs rails of at least ±9V to handle typical line level audio signals. So the power supply circuitry is designed to provide all four of these voltages from the

incoming "raw" 12V DC input, at the modest current levels needed.

As shown in Fig.2, series diode D1 is used to protect the supply from reverse-polarity damage. The 1000µF capacitor provides smoothing before the input is fed to REG1, a 7809 regulator which provides the +9V rail. This, in turn, also feeds REG2, a 7805 regulator which provides the +5V rail.

We generate the negative supply rails by using a 555 timer (IC3). This is wired as a high-speed commutator switch and drives a charge-pump voltage inverter circuit based on diodes D2 & D3 and two 220µF capacitors. This produces an output voltage of about -10V across the second capacitor, which drops to around -9V across zener diode ZD1. The zener thus establishes the -9V supply rail and also drives REG3 to produce the -5V rail.

Finally, we also use the raw DC input to operate the pilot LED, via a 2.2kΩ series resistor.

Construction

Fig.3 shows the wiring details for the Video Distribution Amplifier. Note that this is for the composite video version – we'll cover the S-video version later.

All the parts are mounted on a single PC board coded 02111011 and measuring 198 x 158mm. This board needs to be double-sided to allow correct configuration of the MAX497 video chip but there's no need for plated-through holes. Instead, the connections between the top and bottom copper layers are made via PC terminal pins and by soldering the component leads on both sides of the board where necessary.

We also make use of the top copper layer to provide signal shielding.

Why does the PC board have to be the size it is, when there's not all that much circuitry inside? Well, it's simply to allow all of those output connectors to be fitted directly to the board, along its back edge. This reduces the off-board wiring to zero,

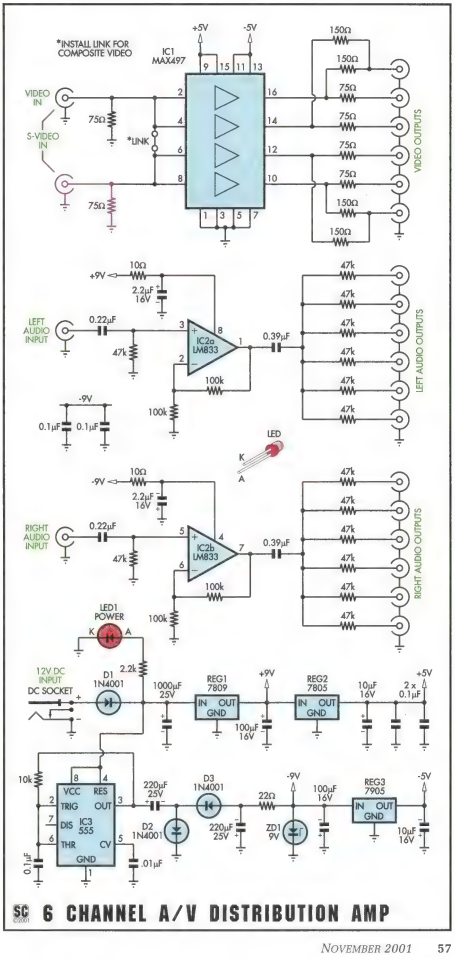
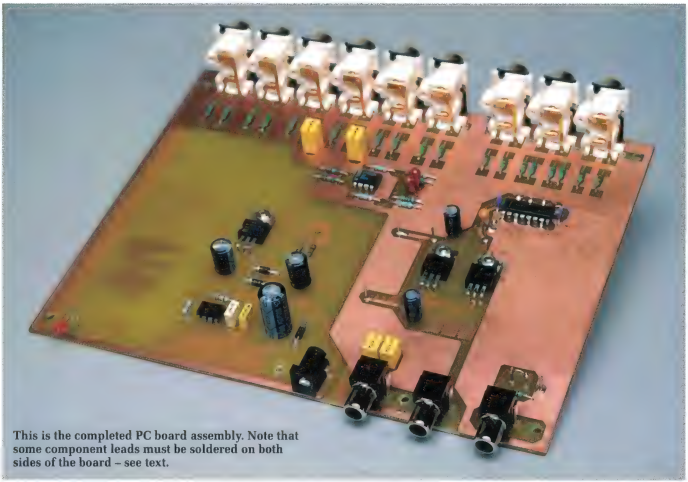


Fig.2 (right): the circuit for the video distribution amplifier. IC1 handles the video signals, while IC2 handles the stereo audio. The circuit can be wired to output six composite video channels or three S-video channels.



This is the completed PC board assembly. Note that some component leads must be soldered on both sides of the board – see text.

making the unit easy to build and eliminating potential wiring errors.

RCA connectors

The video and audio outputs are all made via nine double board-mounting RCA connectors. The three directly behind the MAX497 chip provide the six video outputs, while the remaining six each provide one pair of stereo audio outputs.

At the front, the inputs are made via three single board-mounting RCA sockets. A 2.5mm concentric power connector is used for the 12V DC input and this too is at the front because there was no room at the rear. The only other item on the front panel is the pilot LED, at the lefthand end.

As shown in Fig.3, everything is laid out fairly spaciously, with the signal flow from front to rear for both video and audio signals.

PC board assembly

Before fitting any components to the PC board, position it in the bottom half of the case and check that it has been trimmed to the correct size. The board has to fit quite snugly between the front and rear panels and if it's too large, you won't be able to assemble everything later. It's better to check this out now and if necessary file it down to size, as it's much harder to do if all the components have been

Capacitor Codes

Value	IEC Code	EIA Code
0.39µF	390n	394
0.22µF	220n	224
0.1µF	100n	104
.01µF	10n	103

Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
4	100kΩ	brown black yellow brown	brown black black orange brown
14	47kΩ	yellow violet orange brown	yellow violet black red brown
1	10kΩ	brown black orange brown	brown black black red brown
1	2.2kΩ	red red red brown	red red black brown brown
4	150Ω	brown green brown brown	brown green black black brown
5	75Ω	violet green black brown	violet green black gold brown
1	22Ω	red red black brown	red red black gold brown
2	10Ω	brown black black brown	brown black black gold brown

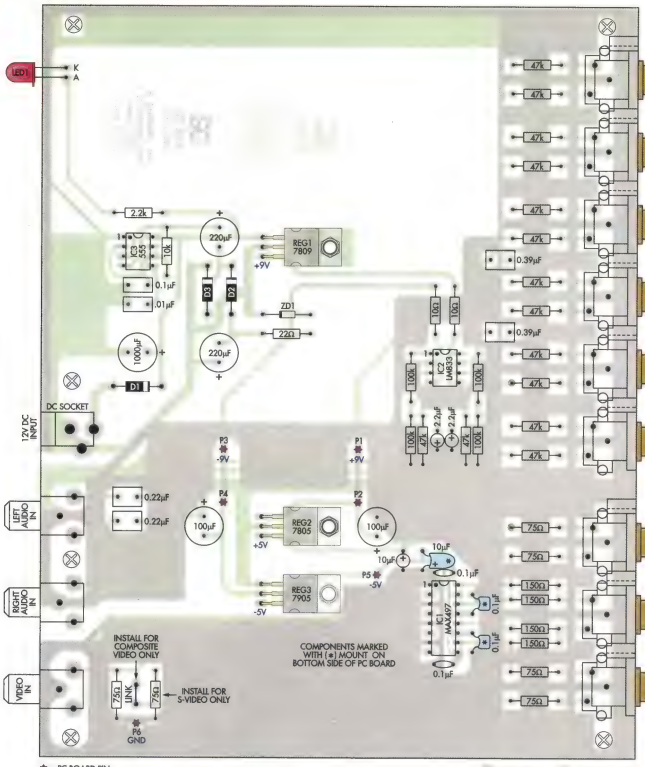


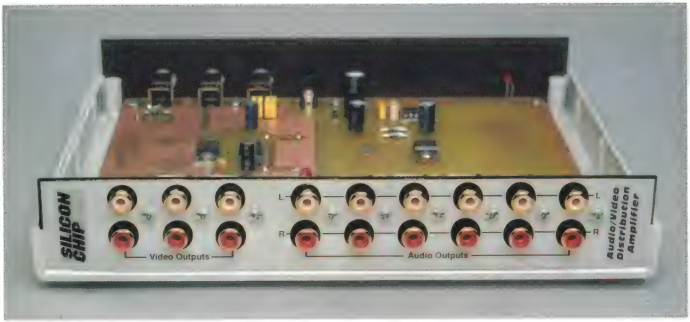
Fig.3: install the parts on the PC board as shown here to build the composite video version. Note that the capacitors shown in blue are installed on the underside of the PC board – see text and photo.

mounted on the board.

Next, it's a good idea to check the board's patterns (top and bottom) for any possible defects – bridges or hairline cracks, etc. Fix these if you find them, then fit the six PC terminal pins (P1-P6) used to make the layer-to-layer connections and the video input linking.

P6 is in the bottom righthand corner of the board, while pins P1-P5 are fitted near REG2 and the two 100µF capacitors. These pins also provide convenient places to check the +9V, -9V and -5V supply rails. Note that all six pins (P1-P6) should be soldered to both the top and bottom copper pads, to ensure they act as through-hole vias.

Install the link near the video input socket if you're building the unit to distribute normal composite video but



The composite video version has no less than 18 RCA output sockets – six for the video outputs and 12 for the stereo audio output pairs. The S-video version substitutes three 4-pin mini DIN sockets for the video outputs, plus another 4-pin mini DIN socket for the video input.

leave it out for S-video.

The next step is to fit the double RCA connectors along the rear of the board and the other connectors along the front. The double RCA connectors have plastic locating lugs on each side, which mate with matching 3mm holes in the board. You push each connector's three connection pins through their holes until the barbs on the plastic lugs clip into position, then you solder the pins to the pads below.

With the single RCA connectors, the connection tails themselves hold the connectors in place but you may need to enlarge the holes in the board to take them because the tails are rectangular in cross-section (about 0.5 x 2.5mm). This is also true for the DC power connector. A round jeweller's file can be used to convert the drilled holes into slots.

This view shows the mounting details for the two 0.1μF monolithic ceramic capacitors and the 10μF tantalum capacitor on the underside of the PC board.

Once the connectors are all fitted and their leads soldered to the board underneath, you're ready for the final stages of the assembly. This simply involves fitting the resistors, capacitors, diodes, ICs and regulators, mainly in that order.

Most of this wiring is very straightforward and shouldn't pose any problems. But be especially careful around the video chip (IC1), because many of its pins have to be soldered to pads on both the top and bottom of the board. Two of the 0.1μF monolithic ceramic bypass capacitors for this chip (the "centre" pair) also have to be mounted on the bottom of the board and soldered on the top. By contrast, the "end" pair are mounted on the top of the board.

It's best to leave all four of these monolithic capacitors until after you have fitted IC1, because they're easier to fit afterwards without damaging them.

When you fit IC1, all of its pins should first be soldered to the pads on the bottom of the board. Then after allowing the chip to cool down for a minute or so, turn the board over and solder pins 1, 3, 5, 7, 9, 11, 13 and 15 to their top pads as well. This done you can then fit the two end bypass capacitors, soldering their leads underneath, and finally the two centre capacitors from below with their leads soldered on the top.

Note that it will be necessary to bend the leads of these two "underneath" capacitors by about 45°, so that they don't foul the bottom of the case

later on – see photograph.

By the way, DO NOT use an IC socket for the MAX497 chip. While it's a fairly pricey chip, it needs to be soldered directly to the board to minimise lead inductance (otherwise it won't operate properly). It's a fairly rugged device though, so don't be too nervous. Just use a clean, well-tinned fine bit on your soldering iron and make the soldered joints quickly to avoid overheating.

The only other part that's mounted underneath the board is one of the two 10µF tantalum bypass capacitors adjacent to IC1. This capacitor bypasses the -5V rail. Again, it may be necessary to bend its leads by about 45° before you fit it, so its body won't hit the bottom of the case when the board is mounted.

Note that all three TO-220 regulator chips are mounted flat on the top of the board. This means that their leads all need to be bent down by 90° about 5mm from the body, before each device is fitted. This done, it's a good idea to fit an M3 machine screw and nut to hold each device down to the board, before soldering the leads on the bottom.

Don't fit the second 75Ω input terminating resistor (near the link) if you're building the unit for distributing normal composite video. This resistor is only needed when the board is used for S-video.

The power indicator LED (LED1) should be fitted with its body about 15mm above the board. Make sure that it's correctly orientated before soldering its leads – the anode lead is the longer of the two. Once it's in, bend its leads at right angles about 8mm above the board, so that it will later mate with its hole on the front panel.

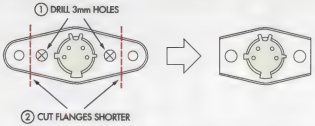


Fig.4: if you want to build the project to distribute S-video signals, here's how to modify the 4-pin mini DIN sockets to fit inside the low profile case.

Final assembly

If you're assembling the unit from a complete kit, the front and rear panels will be supplied punched and silk-screened. Alternatively, if you're building from scratch, you'll have to drill and ream the various holes for the connectors, using photocopies of the front and rear panel artworks as templates.

Note that most of the RCA socket clearance holes should be 10mm or 10.5mm in diameter, while that for the DC input socket should be 7.5mm and that for the LED 3mm.

As you can see from the rear panel artwork, there's also a 3mm hole alongside each double RCA connector position. These holes are used for the small self-tapping screws which attach each connector to the rear panel, to strengthen the complete assembly.

Once all the holes have been drilled in the panels, you're ready for the final assembly. This is easiest if you first offer both panels up to the board assembly so that they mate with the connectors and attach the rear panel using the small self-tappers. The complete assembly can then be fitted into the bottom half of the case and secured by fitting self-tapping screws into the matching integral plastic standoffs – one in each corner, and two more along the front to add strength and rigidity.

Quick checkout

Now for the smoke test. Connect the board to a 12V DC supply (eg, a plugpack) and check the various supply rail voltages using a multimeter

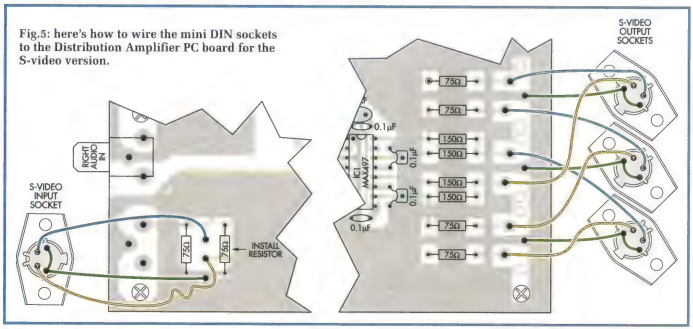


Fig.5: here's how to wire the mini DIN sockets to the Distribution Amplifier PC board for the S-video version.

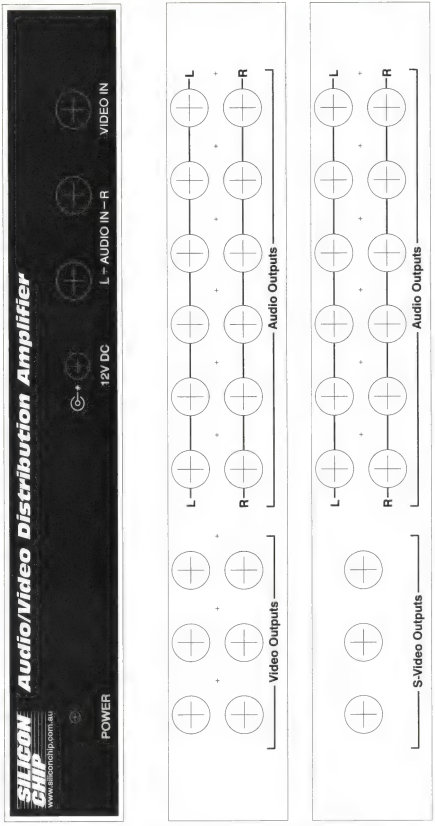


Fig.6: here are the full-size artworks for the front panel and the two rear panel versions (composite video and S-video).

(or DMM). P1 and P2 should both be at +9V (relative to board earth, eg, P6). Similarly you should find -9V at P3 or P4 and -5V at P5.

You should also be able to measure +5V at the output terminal of REG2 – ie, the lead nearest REG3.

If all four voltages are OK, your Video Distribution Amplifier is probably working correctly. If you don't get the correct voltages, remove power immediately and look for the problem. It'll probably be a faulty solder joint or a component mounted incorrectly.

Assuming everything checks out correctly, you can complete the assembly by attaching the top of the case. The unit is now ready for business.

S-video version

Now let's look at building the unit for 1:3 distribution of S-video. Figs.4 & 5 show the details.

First of all, you don't fit the video input RCA socket to the front of the board. Nor do you link the two PC terminal pins just behind the 75Ω input resistor (ie, near the video input socket). However, you do fit the second 75Ω resistor, just behind these pins.

Also, at the rear of the board, you leave off the three double RCA sockets used for the video outputs. Instead, you fit PC terminal pins into the holes where the three pins of each socket normally go and solder them to the pads underneath – ie, nine more terminal pins in all.

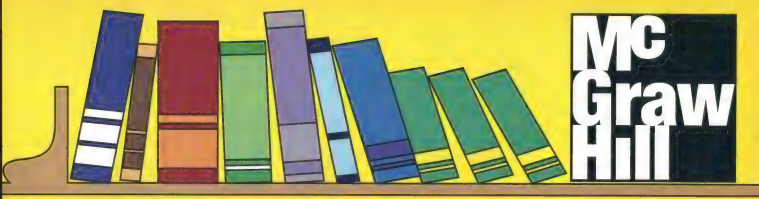
These changes allow you to fit the unit with the usual 4-pin "mini DIN" sockets used for S-video connections, with the sockets mounted directly on the front and rear panels and the board connections made via very short wires to the terminal pins – see Fig.5.

Modifying the S-video sockets

Because of the limited panel space of this low-profile case, the commonly available S-video sockets have be modified to fit in – see Fig.4. This involves drilling new mounting holes in their flanges and then cutting the flanges somewhat shorter – about 24mm end-to-end.

Note that although the unit has only three video output channels in the S-video version, there are still six audio output RCA socket pairs on the rear panel. Only three stereo pairs are required, of course, but you can still fit all six so that there are no holes in the rear panel.

Alternatively, you can leave out three of these double RCA output connectors and their matching 47kΩ resistors and cover the holes with a blanking panel. **SC**



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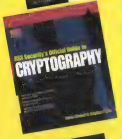

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Download WAV files from your PC and play them at will!

SHORT MESSAGE RECORDER AND PLAYER

by Leon Williams

Got a need for a short audio message player? Been tempted to build or buy a voice recorder? Well, here's a voice recorder with a much-improved recording technique. No longer limited by the shortcomings of built in microphones, you edit and enhance your messages as WAVE files on your PC and then download them direct to the Message Player.

While there have been many projects for voice recorder/playback boards, they all suffer from one major drawback.

They can only record and playback sounds (usually voice) that are recorded by a little onboard electret microphone. You push a button and speak into the microphone and that's about all you can do. You can't really add any exciting sound effects or enhance your voice in any way.

With the Message Player all that's changed. Now you can record, mix and edit sophisticated sound files with your PC and download them to be played when and where you want.

OK, so where would you use the Message Player? The answer is any place that you want short audible messages to be heard.

What about a personalised front door bell or a warm message to welcome shoppers, or maybe a talking car alarm to tell you your lights are on?

A unique application could be to replace your telephone ring sound with a voice message like "Hey you, answer the phone"! All you would need to do is detect the ring signal and trigger the Message Player to play the message.

The Message Player has a replay time of four seconds and in replay mode has only two controls. These are a logic level negative pulse to start the replay ("GO") and a similar pulse to stop the replay ("STOP").

If the message is not stopped during the four seconds it will stop automatically at the end. If you want the message to continue, it's simply a matter of holding the GO input low until you want it to stop.

These pulses can be derived from simple pushbutton switches or other more elaborate interfacing circuits.

If you think that the Message Player memory is not big enough, just time yourself speaking for four seconds and you will see that you can get a lot said in that time. The Message Player is only intended for short message applications and anyway, who needs a 60 second message every time a wanted event happens?

To download the sound files into the player, you connect it up to your PC printer port with a standard male-to-female 25-way cable. The download software is started and the required file opened, the shunt on the PC board is moved from PLAY to PROGRAM and the file is then downloaded. It is very easy and takes about 15 seconds to complete.

The message player is built on a single-sided PC board, with all the components on-board except for the loudspeaker and the power and D connectors.

All the components are standard types available from most electronics shops. The exception may be the SRAM chip. These have been used by the millions over the years, so you may be able to locate one from a disposal source. Failing this, you can get them new from places like Farnell and RS Components.

MESSAGE PLAYER FEATURES

- Stores standard WAVE (.WAV) file format
- Battery back-up for memory
- Quick PC file download
- Simple logic control interfacing
- Built in 250mW audio amplifier
- Easy to use companion software
- Runs from 9V plug pack at low power

While a 62256 is specified for the storage SRAM, manufacturers sometimes use different labelling, such as 43256. This should be fine, remembering that the majority of 32K SRAM chips have the same pin outs and functionality. Don't worry about the access time, usually written as a couple of digits at the end of the part number, perhaps preceded with a dash.

This is not a critical issue with the Message Player, so if you are purchasing a new one, select the slowest to save some money.

The Message Player is housed in a plastic case but there is no reason why it couldn't go into an existing piece of equipment if you have the space. The normal power supply would be a 9V plugpack but any regulated DC source between 8V and 12V will also be suitable.

Wave files

WAVE (".WAV") files are probably the most common audio file format used in PCs and the Internet because there is plenty of software to generate and play them. They don't employ complicated compression algorithms but instead just have a header block followed by the raw audio data.

WAVE files come in a number of formats providing varying levels of sound quality from basic to CD quality.

To keep the Message Player inexpensive, it has been designed to only work with 8-bit mono 8kHz files. This means that we don't need a lot of memory to hold the files and so we can get away with a single SRAM chip.

While the Message Player sound output is not exactly hifi, it is entirely adequate for the purpose.

Let's have a closer look at the WAVE file format we are using.

The start of the file contains a header block, a block of data that provides information about the file including things such as the sampling rate and the size of the file.

We won't go into it in depth here but if you are interested, a search on the Internet will uncover plenty of information about the different WAVE file formats, including full descriptions of the header block.

Mono obviously refers to the fact that there is only one channel of audio, hence the reason we only use one speaker! The frequency of 8kHz refers to the rate at which each byte of data is converted from digital to analog to produce sound. At 8kHz (8000 bytes per second), we can reproduce voice quite well but reproducing high frequencies such as 15kHz is not possible. At this rate we can get four seconds of replay from a 32Kbyte file.

Each byte of audio data is held as eight bits, which gives us a maximum of 256 different bit combinations. The reproduced audio waveform is comprised of 255 equal voltage steps and will be at minimum amplitude when all the bits are zero (00 Hex) and at maximum amplitude when all the bits are a one (FF Hex). A feature of the WAVE format is that when there is silence (no sound), the amplitude rests at midway (7F Hex).

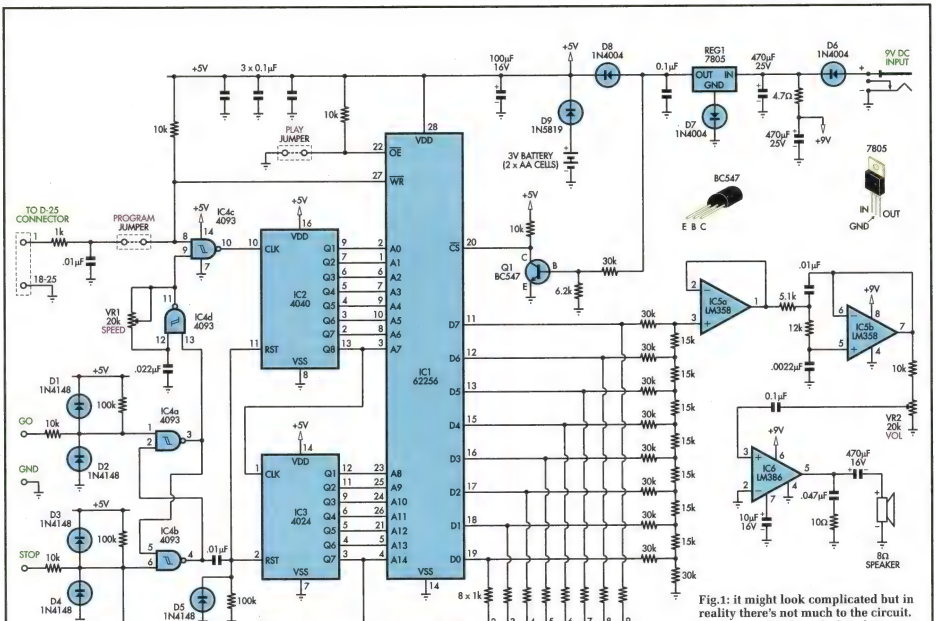


Fig.1: it might look complicated but in reality there's not much to the circuit. Its operation is described in the text. Note that the two jumpers were brought out to a DPDT slide switch in our final prototype.

SC MESSAGE RECORDER & PLAYER

Perhaps a more correct way of looking at a WAVE file is that it swings negative and positive about a central resting point.

Circuit description

The circuit is shown in Fig.1. The audio file is stored in IC1 which is a 32K (32768) by 8-bit wide SRAM (Static Random Access Memory) chip. As this is the heart of the design, let's have a close look at how it operates.

An SRAM chip looks like any other logic chip with a black plastic body and pins. The difference is that it can hold lots and lots of bytes (eight bits) of data, which can be entered (written), stored and read back very quickly.

Each location (memory cell) within the SRAM is selected by the bit pattern on the address pins. When all the address lines are low we select the first memory cell. As they increment in binary they select the next byte and so on, until they are all high when the last memory cell is selected.

The SRAM chip we are using is a 62256, where the sequence 256 refers to the fact that it can store 32K x 8 bits (32 x 8 = 256). A 6264 would store 8K x 8 bits, etc. Our chip has 15 address lines to address a maximum of 32,768 locations, and eight data lines.

Those who have access to a 32K SRAM data sheet will notice that the address and data line labelling is different to that shown in Fig.1. This was changed in this instance to simplify the PC board layout, however changing the notations does not cause a problem.

The term random in SRAM refers to the fact that any memory cell within the chip can be accessed (written or read) in any sequence.

The data lines can also be interchanged, as long as we read and write the data with the same bit pattern. That is, if we write a bit to a line we label D7, then we must also read back the bit as D7.

Because we do not need to access the memory cells in any particular sequence and because all the data bits can be treated equally, we can label the address and data lines as we wish.

As well as the address and data lines, the SRAM has three control lines that must be used correctly to write and read the SRAM. Pin 27 is the Write (WR) pin and is normally high. It is taken low when writing eight bits of data into a cell selected by the address lines. To read data back from the chip, the write line must be high.

Pin 22 is the Output Enable (OE) pin and controls the output buffers. When high the output is disabled and placed in a high impedance state, while taking it low enables the output buffers.

Pin 20 is the Chip Select (CS) input and when it is high the chip is deselected. In this state, read and write requests are ignored and the chip is placed in standby mode. When the chip select pin is low, the chip operates normally and data can be read and written.

In contrast to memory devices such as EPROMs and EEPROMs, IC1 is a volatile memory. This means that it will only hold the data in its memory cells while power is applied.

Luckily, the memory can be maintained when the main power is removed, through a secondary battery backup, as long as pin 20 is held high. The backup supply can be as low as 2V, needing a current of only a few microamps.

This can be easily supplied by a couple of AA cells which under these conditions should last a long time, probably as long as they would left on the shelf.

This shot of the inside of the message recorder was taken before we decided to add the two pushbuttons switches ("GO" and "STOP") on the end panel, as well as bringing the "PROGRAM" and "PLAY" headers out to a slider switch on the front panel. These switches make the unit much easier to use: you don't have to whip the front panel off every time you want to change the message!

Addressing and control

IC2, a 4040 12-stage binary counter, is used to address the first eight lines of the SRAM. The clock input is on pin 10 of IC2, and a high on pin 11 resets all outputs to zero. IC3, a 4024 7-stage binary counter, addresses the remaining seven lines of the SRAM and is clocked when pin 13 of IC2 goes low.

The reset line of IC3 is connected to the reset line of IC2, so that both are reset simultaneously.

IC4d is configured as a Schmitt trigger clock oscillator with a frequency of 8kHz, set by the .022µF capacitor and VR1. With the clock operating at 8kHz, we address 8000 memory locations per second.

The memory size is 32,768 bytes, so the time taken to address all the memory, and hence the replay time is 32,768/8000 = 4.096 seconds.

The clock is enabled when pin 13 is

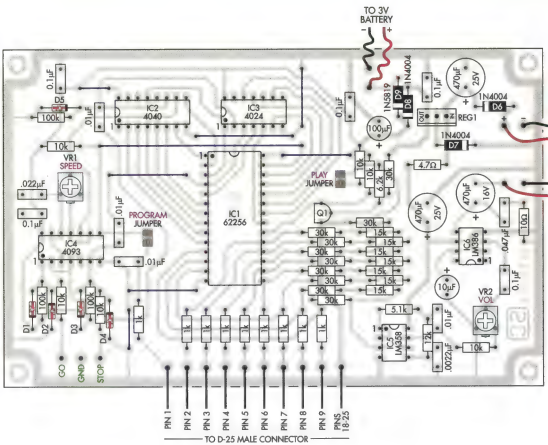


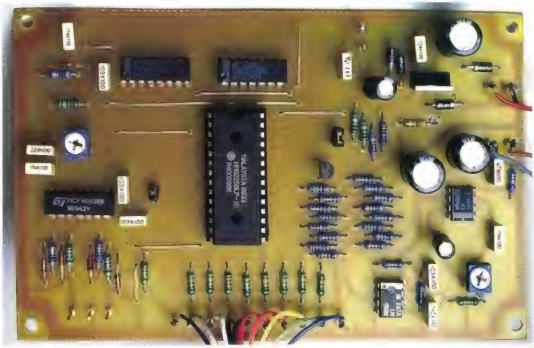
Fig.2: almost all the components mount on one PC board, as shown here. The two "jumpers" (for programming and playing) can be moved to a front panel DPDT switch to save opening the case every time you want to change the message. Likewise, the "GO" and "STOP" PC stakes can be brought outside the case.

taken high and stops when pin 13 is low. Pin 8 of IC4c is normally held high by a 10kΩ resistor, so clock pulses can pass through via pin 9 and onto the address counters.

When the clock is stopped, IC4d pin 11 is forced high, which allows the write pulses through IC4c in program mode. More on this later.

Starting and stopping of the clock and hence the replay is controlled by IC4a and IC4b. This crossover configuration is called a set-reset flipflop, and toggles between two states. Pin 1 of IC4a and pin 6 of IC4b are normally held high by 100kΩ resistors.

Assuming pin 3 of IC4a is low, pin 4 of IC4b and hence pin 2 of IC4a will be high. When the GO input is pulled low, pin 1 of IC4a is pulled low, forcing pin 3 to go high. This enables the clock and forces pin 4 of IC4b to go low. Even when the GO input is taken high again, the flipflop stays in



Compare this picture with the component overlay above when assembling the PC board and you shouldn't have any problems.

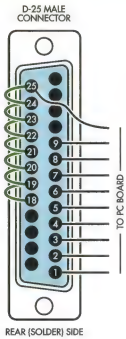


Fig.3: here's how to wire the 25-pin "D" socket which connects to your PC via a standard parallel cable. Pins 18-25 would normally be soldered together with a straight length of tinned copper wire.

same state. The flipflop will only change state when pin 6 of IC4b is pulled low. This can occur in one of two ways:

(1) by pulling the STOP input low; pin 3 of IC4a then goes low, disabling the clock and forcing pin 4 of IC4b high.

(2) when pin 6 is pulled momentarily low by the negative pulse generated after the last memory cell has been addressed. This is accomplished by differentiating the negative edge of IC3 pin 3 with a .01µF capacitor and a 100kΩ resistor.

In a similar way, the rising edge of IC4b pin 4 is differentiated by a .01µF capacitor and a 100kΩ resistor, creating a high-going pulse to reset the address counters. Diode D5 is employed to limit negative spikes which could damage the ICs when IC4b switches from high to low.

Because the GO and STOP inputs may be controlled from external control circuits, diodes D1-D4 and the 10kΩ resistors are included to protect the inputs from excessive current and voltages.

In summary, the start/stop operation works like this. Pulsing the GO line low starts the clock and the replay.

Parts List – Message Player

1 PC board, code 01111011
1 plastic case, 197mm x 113mm x 63mm (Jaycar HB6012 or equivalent)
19 PC board stakes
2 2-pin headers with shunts, OR
1 DPDT mini slider switch
1 2-pin header shunt
1 25-pin male D connector with mounting hardware
1 76mm 8Ω speaker
1 DC panel-mount socket to match plug pack
1 28-pin IC socket
1 Twin AA battery holder
4 12mm x 3mm screws and nuts
4 Self adhesive feet
Light duty hook up wire, tinned copper wire,10-way ribbon cable
Double-sided tape pads (for securing battery holder)

Semiconductors
1 32K x 8 SRAM 62256 or equivalent (IC1)
1 4040 12-stage binary counter (IC2)
1 4024 7-stage binary counter (IC3)
1 4093 quad NAND gate (IC4)
1 LM358 dual opamp (IC5)
1 LM386 audio power amp (IC6)
1 BC547 NPN transistor (Q1)
5 1N4148 signal diodes (D1-D5)
3 1N4004 power diodes (D6-D8)
1 1N5819 Schottky diode (D9)
1 7805 positive 5V regulator (REG1)

Capacitors
2 470µF 25VW PC electrolytic
1 470µF 16VW PC electrolytic
1 100µF 16VW PC electrolytic
1 10µF 16VW PC electrolytic
5 0.1µF MKT polyester
1 .047µF MKT polyester
1 .022µF MKT polyester
4 .010µF MKT polyester
1 .0022µF MKT polyester

Resistors (0.5W, 1%)
1 4.7Ω 1 10Ω 9 1kΩ 1 5.1kΩ 1 6.2kΩ 6 10kΩ
1 12kΩ 7 15kΩ 10 30kΩ 3 100kΩ
2 20kΩ horizontal trimpots (VR1, VR2)

Pulsing the STOP input low during a replay will stop the clock and the replay. Replay will also stop automatically when the last address line goes from high to low.

It is also possible to replay continuously by holding the GO input permanently low. In this case, there will be a small gap in the replay as the address counters go from maximum count to zero at the end of the message but it is hardly noticeable.

Sound generation

To read data from the SRAM, the shunt must be in the Play position. As each memory cell is addressed, the respective data will appear at the data pins.

The array of 15kΩ and 30kΩ resistors connected to the data pins forms what is referred to as an R/2R digital-to-analog converter. This type was chosen because it is much cheaper than a dedicated D-to-A converter IC, and in any case does an excellent job in this circuit.

The voltage at the D-to-A output is buffered and appears at pin 1 of IC5a. It has a resolution of 256 equal steps

ranging from around 0V to 5V. 0V represents the minimum level of the audio waveform and 5V the maximum of the audio waveform, while 2.5V is the rest or silence level.

IC5a is wired as a non-inverting buffer and has a very high input impedance. This is necessary to stop the low impedance of the following circuits loading the D-to-A converter and reducing its accuracy.

Due to the low sampling rate used (8kHz), the audio waveform needs to be low-pass filtered to remove high frequency components and improve the listening quality.

IC5b is configured as a 2-pole low-pass filter with a cut-off frequency of 4kHz. The output level is quite high at this point, so a 10kΩ resistor is included between the output of IC5b and the volume control to avoid overloading the audio power amp stage.

The signal from the volume control is capacitively coupled to the audio power amp IC6. This is a well-proven circuit using an LM386 in its basic form, driving an 8Ω speaker.

A 4.7Ω resistor and a 470μF capacitor provide supply decoupling, while the .047μF capacitor and 10Ω resistor connected to pin 5 help to prevent instability in the output stage.

Power supply

The power supply is a standard 7805 3-terminal voltage regulator fed from a 9V plugpack. The circuit draws minimal current, so one rated at say, 150-300mA, will be ample.

Avoid using a plugpack with a higher voltage rating, because the LM386 is not designed to withstand a supply voltage much greater than 12V. Of course, you can use a 9V regulated supply if you prefer.

Diode D6 is used to prevent damage to the circuit from supplies connected with reverse polarity and a 470μF capacitor smoothes the usually unregulated plugpack output.

The regulator is 'jacked up' with a diode (D7) in the ground lead, giving an output voltage of 5.6V. A 0.1μF capacitor is included at the output of REG1 to help prevent instability.

The output voltage is reduced back to 5V by diode D8 which feeds the main circuit. The audio sections are powered from the unregulated supply and consequently do not operate when the main DC power is removed.

Battery backup

Diode D9 is used to connect the battery backup supply when the main supply is removed. With the main supply connected, D9 is reverse-biased because the cathode is more positive than the anode, so no current flows from the batteries.

However, when the main supply is missing, D9 conducts and the batteries supply power to the SRAM.

D9 is a Schottky diode, which has a much lower forward voltage drop (about 0.3V) than a normal diode and is used to maximise the SRAM data retention time as the battery ages.

A typical SRAM will hold its memory with a supply as low as 2V. With 3V or more from a pair of new AA cells, minus the 0.3V drop in the Schottky diode (D9), around 2.7V is available for the SRAM.

Transistor Q1 is normally biased on due to the base resistor connected to the output of REG1. The collector of Q1 is connected to the Chip Select line of IC1, so when main power is connected, CS is pulled low, enabling normal chip operation.

When the main power is disconnected and the output of the regulator goes below 4V, Q1 turns off and CS is pulled high. When CS is high the SRAM is placed in standby mode and consumes very little power. The CS lead must be high before the battery backup supply switches in otherwise the data retention will not work.

The keen-eyed will notice that the battery backup supply is also connected to the remainder of the logic ICs. These are CMOS chips with minimal current drain and so do not significantly degrade the expected battery life.

Programming

Programming is done by connecting to the 25-pin parallel or printer port of a PC operating under DOS or a DOS box in Windows 95 or Windows 98 (Windows NT, Me and 2000 use the parallel port differently and may not work properly).

The data to be programmed into the SRAM is output in parallel on pins 2-9, and the negative going programming clock pulses are output on pin 1. The ground connection is made through paralleled pins 18-25.

To place the board into program mode, the shunt must be moved from the Play header onto the Program header pins. This causes pin 22 (Output Enable) to go high, disabling the output buffers, and connects the PC clock signal to IC4c and pin 27 (Write) of IC1.

Before programming starts, the replay must be stopped so that the address counters are reset and addressing the first memory location. The 1kΩ resistors couple the data leads from the PC into the data pins of IC1 and also protect the inputs from damage from surge currents. The resistors associated with the D-to-A converter are much higher in value than 1kΩ and so do not interfere with the programming process.

A 1kΩ resistor and a .01μF capaci-

Table 1: RESISTOR COLOUR CODES

No.	Value	4-Band Code (1%)	5-Band Code (1%)
3	100kΩ	brown black yellow brown	brown black black orange brown
10	30kΩ	orange black orange brown	orange black black red brown
7	15kΩ	brown green orange brown	brown green black red brown
1	12kΩ	brown red orange brown	brown red black red brown
6	10kΩ	brown black orange brown	brown black black red brown
1	6.2kΩ	blue red red brown	blue red black brown brown
1	5.1kΩ	green brown red brown	green brown black brown brown
9	1kΩ	brown black red brown	brown black black brown brown
1	10Ω	brown black black brown	brown black black gold brown
1	4.7Ω	yellow violet gold brown	yellow violet black silver brown

Table 2: CAPACITOR CODES

Value	IEC code	EIA code
0.1μF	100n	104
.047μF	47n	473
.022μF	22n	223
.01μF	10n	103
.0022μF	2n2	222

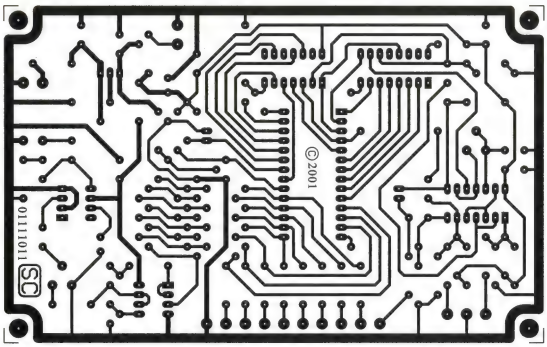


Fig.4: the full-size PC board pattern, ready for you to make your own or to check commercial boards for any defects. This pattern can also be downloaded from the SILICON CHIP website.

tor filter the programming clock input, to eliminate unwanted noise from providing false write pulses. Before programming starts, pin 9 of IC4c will be high and as the programming pulse is also high, pin 10 of IC4c will be low.

Programming starts with the PC outputting eight bits of data onto the data leads. The programming clock line is pulsed low, pulling the Write pin of IC1 low and writing the data into the addressed memory cell. When the programming pulse goes high again, pin 10 of IC4c goes low, clocking the address counters onto the next location.

It is important when programming memory that the address and data lines are steady while the Write line is pulsed low and returns high. At first glance, the circuit may seem at odds to this requirement. However, the address counters will not change state until well after the Write line has been taken high due to the propagation delay in IC4c, IC2 and IC3.

The software repeats this process until all the memory locations have been programmed. The rate that the programming pulses are generated and hence the total programming time could have been much faster but it has been purposely slowed down. This has been done to avoid any problems that might arise with long cable lengths and different PC printer ports. In any case, the whole process only takes about 15 seconds on an average PC.

At the conclusion of programming the shunt is moved back to the Play position. A 10kΩ resistor holds the Write pin high when the shunt is removed, avoiding unwanted writes to the SRAM.

Construction

Start construction by assembling the PC board. There are seven wire links to be installed, so do these first. Ensure they are straight and lay flat on the PC board. Follow this with the smaller components, such as the PC stakes, IC socket, trimpots, resistors and diodes.

Next, install the capacitors, ensuring that the electrolytics are installed with correct polarity. Follow this with the transistor and ICs but leave the SRAM chip until later. Note that not all the ICs face the same way, so check the component overlay diagram before soldering them in.

Take care with the CMOS chips, by trying to avoid touching the pins, earthing yourself before holding them and soldering the power supply pins first. The 5V regulator (REG1) is installed with its metal tab facing into the PC board. It runs cool and won't need a heatsink.

Once the PC board is loaded you can prepare the case which needs to have a number of holes made in it. See the photographs as a guide. Start with a hole to mount the DC socket at the righthand end of the case.

The D connector is mounted on the side of the case near the programming PC stakes. The rectangular cutout for the D connector is easily made by drilling a number of large holes and finishing to shape with a small file. You will also need to drill two holes on either side of the cutout to secure the connector with the mounting hardware.

Place the PC board on the bottom of the case, locating it so that there is enough room at the lefthand end to sit the battery holder. Mark the positions of the holes, remove the PC board and drill with a 3mm drill. Drill a pattern of holes in the middle of the lid to allow sound to escape from the speaker. If you use the specified case you'll find dimples on the underside of the lid which make drilling neat, evenly-spaced holes relatively easy.

Once the case has been prepared, install the DC socket and D connector and mount the PC board in the case with 3mm screws and nuts. An extra nut is placed on each screw between the case and the PC board to act as a spacer.

Mount the speaker on the inside of the lid with a bead of silicone adhesive placed around the edge and leave to cure.

The DC socket and the speaker are wired to the PC board stakes with hookup wire. Ensure that the speaker wires are long enough to allow the lid to be removed and placed alongside the case. The D connector is wired to the PC board using a short length of

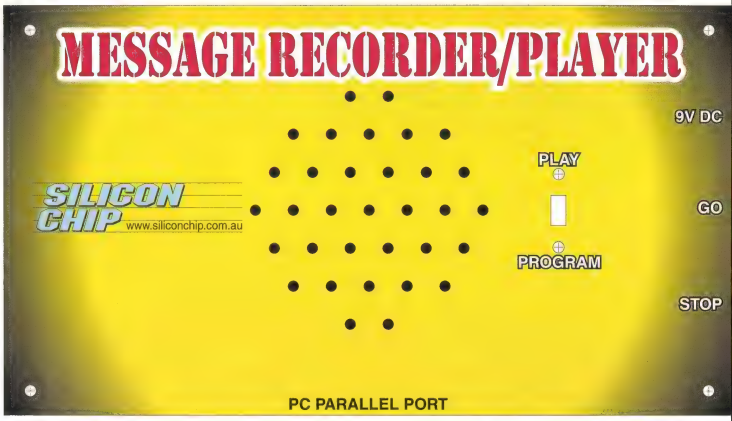


Fig. 5: here's the full-size artwork for the front panel. You can photocopy this or if you want it in colour, download it from www.siliconchip.com.au. As you can see, this panel incorporates a switch for the Play/Program function and also brings the "GO" and "STOP" pins outside the case. Exactly how you do this is up to you!

multi-coloured ribbon cable, with pins 18-25 of the D connector soldered together with a piece of bare tinned copper wire.

The battery holder is placed at the end of the case and soldered to the battery PC stakes using the wires that come with the holder.

Apply four self-adhesive feet to the bottom of the case when finished.

Initial testing

Once construction is complete, check your component placement and soldering carefully. Remember that the SRAM chip should not be in place yet.

If all appears OK, connect the plug pack to the DC socket and measure the voltage at the power supply socket with a multimeter.

This should be somewhere around 9-12V, depending on the plugpack used. Next, measure the voltage at REG1's input, which should be around 0.6V less. Then check the voltage at the junction of D8 and D9, which should be close to 5V. If not, disconnect power quickly and look for errors, especially with the power wiring and the installation of the polarised components.

When you are satisfied that the power supply is working, remove the supply and adjust the two trimpots to mid-position. Now plug the SRAM chip into its socket (with pin 1 closest to IC2) and place the shunt in the Play position.

Apply power again, and briefly ground the GO input. A raucous noise should come from the speaker for about four seconds as the SRAM outputs its random data. Ground the GO input again and then momentarily ground the STOP input to check that the replay stops before the 4-second period elapses.

Now permanently ground the GO input and measure the frequency of the clock at pin 11 of IC4d. Adjust VR1 until it is as close as you can get to 8kHz.

In the unlikely event that no sound comes out, check firstly that VR2 is turned from the ground position. If this appears OK then you will have to check out the other parts of the circuit, such as the oscillator and the audio stages.

Fault finding will be a lot easier if you have access to an oscilloscope, however with the foregoing description of the circuit you should be able to find most problems with just a multimeter and monitor amplifier.

The software

To download files into your Message Player, you will need to load the companion software file called MSGPLAY.EXE. This is available from the SILICON CHIP website and comes as a zipped up file.

Once you have downloaded the file, unzip it using WinZip and copy it to a new folder on your PC. Use this folder to store all your generated sound files, as it makes them easier to find if they are all together.

MSGPLAY is a DOS program, and is obviously designed to work with a PC running DOS. However, it runs quite happily in a DOS window under Win95 or Win98.

As previously mentioned, Win NT, Me and 2000 operate differently and will not work properly with MSGPLAY. (Everything appears to be working but the WAV file doesn't download).

When you run MSGPLAY you will be greeted with an opening menu

screen. On this menu you have four options, which you highlight with the Up and Down arrows keys and then choose by pressing Enter.

The program is easy to drive and provides lots of on-screen messages to help you through. The Open file menu allows you to enter a file name for opening, the Download menu steps you through the download process and choosing the final option exits you from the program.

The Setup menu is the third option and allows you to select the printer port that you have the board connected to (usually LPT1) and also provides two test files for downloading. These files can be used if you think you have troubles with the hardware, or you simply can't wait to hear something other than noise come out the speaker.

The first file is four seconds of 1000Hz sinewave, which you can use to test that the whole board and the PC connection is working. The second test file is a 31Hz sawtooth wave with 256 steps. If you download this file and run it, you will be able to check the linearity of the D-to-A converter with an oscilloscope connected to pin 1 of IC5a.

Making files and downloading

Producing your own WAVE files is quite easy. Every PC that has a sound card and a sound recorder program can make WAVE files. To make advanced ones, through editing, mixing and adding special effects, you really need a special sound file editor.

Don't think that you have to rush out and spend a fortune on software, because you can download shareware or freeware from the Internet. They may not give you all the features of a professional sound file editing program but you'll still be able to produce exciting results.

Just get on the Internet, use your favourite search engine and start searching. (The Google search engine is built into www.siliconchip.com.au).

The file that you create must be mono, 8kHz and 8-bit. If you have created it under another format, you need to convert it first. Just to make sure, the download software inspects the file when it is opened and informs you if it is not suitable.

If your final file is large, you will only be able to store the first 32KB. If your file is smaller than 32KB, the download software will fill the remainder of the SRAM with silence (7F Hex).

So let's download and play a file. Firstly, run the download program, select the Setup option and choose the connected printer port. Then select the File open option and enter the file name. Select the Download option and follow the instructions. Place the shunt in the Program position and connect the cable.

Start the download and you will see the counter showing you the progressive count as the bytes are written to the SRAM. You will also notice, as the download is progressing, that you can hear in slow time the file that you have created. This is quite normal as the data being downloaded to the SRAM is also fed to the D-to-A converter and audio amplifier but at a much slower rate than normal.

Once the downloading is finished, move the shunt to the Play position and disconnect the cable.

Pulse the GO input low (eg, short it to 0V) and you will hear your creation being played. To change the playback volume, adjust volume trimpot VR2 with a small screwdriver.

Now is a good time to check the battery backup operation. Insert two new AA cells into the battery holder and disconnect the plugpack. Wait a few minutes and then re-connect the plugpack.

Ground the GO input and if the file is still in the SRAM, you will hear it being played. If not, it may be that the batteries are in the wrong way or that diode D9 was installed with the incorrect polarity. Or the batteries could be flat!

Interfacing

The Message Player requires inputs to start and stop the replay. We'll leave it up to you to work out an interface for your particular application.

The robust GO and STOP input circuits allow a wide range of control possibilities.

The simplest way is to use two pushbutton switches wired between the inputs and ground for manual control.

However, if you have external inputs they can be either 5V negative-going pulses from logic circuits or a set of normally-open relay contacts or even open-collector transistor switches.

Remember that the GO input must be normally high and grounded momentarily to start replay but you only need a similar STOP pulse if you don't want the full 4-second replay.

If you build a small interface board, you'll find plenty of space within the case to mount it and you'll probably be able to power it from the existing plugpack supply as well. SC

PRODUCT SHOWCASE

Need a new battery for your cordless drill? Here's one!

If you've ever had to buy a replacement battery for a cordless drill, you'll know just how much they cost: usually the original price of the drill PLUS an arm and a leg. $70-$100 is common!

Dick Smith Electronics have come up with the perfect solution. Don't replace the battery: replace the whole thing!

For less than forty bucks, you'll get a 14.4V cordless drill with a 10mm keyless chuck, electronically-controlled variable speed (0 to 550rpm), forward and reverse switching and six-torque settings.

It also has a 3-5 hour charger and even a screwdriver bit and a plastic carry case!

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Website: www.dse.com.au

Small business UPS

American Power Conversion (APC) have available 350W or 500W uninterruptible power supplies (UPS) designed to give small offices time to properly close files and shut down systems when power fails.

"Power disturbances account for 45% of all computer availability problems," said Leanne Cunnold, APC Managing Director (Aust & NZ).

Depending on the computer type, the Back-Up CPS can give up to 20 minutes or so operation from its own battery after mains power fails. It also protects against power surges, including phones, faxes, modems, etc within its guard, including RJ-45 and USB ports for connection with the workstation. File-saving, auto-shutdown software for both Windows and Mac is included with each UPS.

Recommended retail price of the 350VA model is $221.00, while the 500VA model is $315.00.

Contact:
American Power Conversion
Phone: (02) 9955 9366
Website: www.apcc.com

"Speedskins" convert keyboards for learning

It is considered very difficult to learn to touch type when you can see the keyboard letters – the temptation to "peek" is simply too great, slowing the learning process signficantly.

If you're in the position of teaching computer skills – or want to learn better – a Speedskin could be the answer. It is a flexible but opaque keyboard cover which doesn't stop the keyboard being used, it simply hides the letters.

It doesn't cover the whole keyboard, only the alpha and numeric keys. And because keyboards are virtuallty all made to the same size, they'll fit notebooks and laptops as well as conventional keyboards. They can even be separated for ergonomic keyboards.

They are also available in DVORAK layout for those who want to learn this supposedly more efficient system.

Speedskins should be available from most computer and stationery stores for around $19.00 to $24.00.

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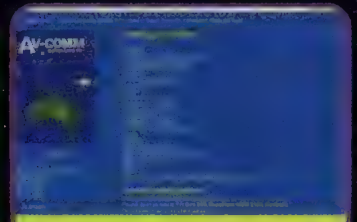

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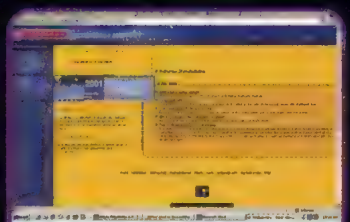

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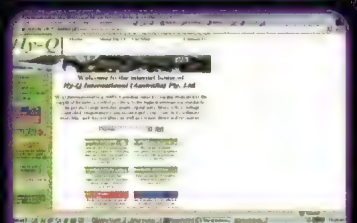

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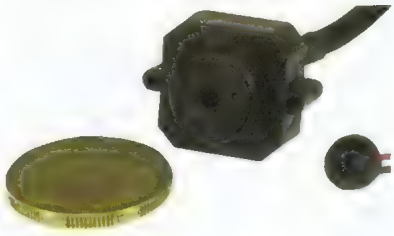

This colour video camera measures just 20 x 20 x 16mm and is ideal for remote surveillance situations where a more-expensive CCD camera is not required.

It is ideal for checking visitors at the front door, monitoring a sleeping baby or keeping an eye on the swimming pool. The camera has a composite video output so it can be connected directly to a video recorder or the A/V input of a normal TV.

It sells for $159.95 (Cat. QC-3459).

. . . and an 810 minute Digital Voice Recorder

A new Samsung digital voice recorder from Jaycar will store up to 810 minutes (Yes, that's 13.5 hours) of digital voice quality audio in a neat, slim hand-held unit.

Four separate message groups are available and each group can have up to 100 messages. The recorder has an integrated LCD to show the status of various functions including battery condition, rec/playback level, message number & length, message group, etc. Also included is a VOX function and variable microphone sensitivity for voice operated recording.

Software is included to enable messages to be downloaded to a PC via the printer port and e-mailed to friends or business colleagues. Accessories include an 2 x AAA batteries, earphone, microphone, line-out cable and a telephone adaptor.

However, the telephone adaptor is NOT approved for use in Australia.

Price at all Jaycar Electronics stores is $ 449.95 (Cat. XC-0280).

Contact:
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100 Silverwater Rd, Silverwater NSW 2128
Phone: (02) 9741 8555
Fax (02) 9741 8500
Website: www.jaycar.com.au

How to Do Everything With Your Scanner

If you own a scanner – and more than one third of homes with Internet access also have scanners – do you get the most from it?

If you're typical of most users you're probably only using a fraction of its capabilities.

Many people use their scanners only to send photos to their friends, not realising there's so much more they could do.

Now there's a new book from McGraw-Hill which can really answer all those scanner questions for you:

"How to Do Everything with Your Scanner" by Jill Gilbert, describes not only how to use a scanner to capture a wide variety of images, it offers advice and tips on image and color correction and provides details on using photo editing software to edit, repair and modify scanned images

There are also scanning projects for all members of the family, including creating a logo, stationery, adding images to a web page or e-mail and there is even an 8-page colour insert that shows step by step progress for repair/restoration of damaged photos and several of the included sample projects.

With a recommended retail price of $44.95, this book (along with many others in the McGraw-Hill Technical range) is available from Dick Smith Electronics, Jaycar Electronics, Altronics, Technical Books (Melbourne) and all good bookstores.

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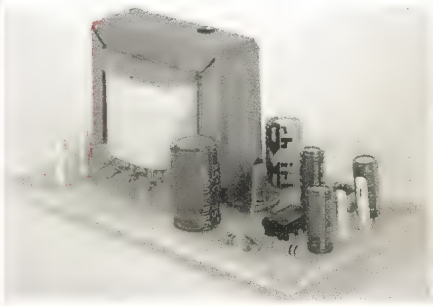

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CAN BUS Analyser from Yokogawa

The Controller Area Network (CAN bus is widely used for automotive factory automation and other applications, The Yokogawa DL7200 CAN BUS signal analyser captures and analyses the waveforms of bus signal that previously proved difficult with conventional protocol analysers.

It comprises a multichannel digital oscilloscope with four analog channels and 16-bit logic input channel (optional) as its base unit. Users can analyse the CAN bus in synchronisation not only with its signal but also with other signals, such as a signal from a sensor or a control signal sent to a module. Using this feature along with the CAN bus trigger and analysis functions, users can efficiently evaluate and debug the overall range of system.

The CAN Bus Analysis Function analyse waveform data existing on the CAN bus and acquire into long-record length memory with a maximum of 1 megawords (MW) in a time-series manner.

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CIRCUIT NOTEBOOK

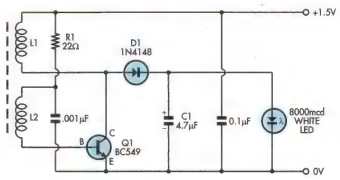
Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

Alternative circuit for a white LED torch

This is an alternative approach to the circuit for the White LED Torch in the December 2000 issue. It will give a usable light from a battery with an open circuit terminal voltage of 0.5V (that's so flat that it will not run anything else at all).

The circuit will drive an 8000mcd high intensity white LED to 20mA at 3.6V from a single 1.5V cell or, by changing a resistor, from a single 1.2V rechargeable cell. The LED used for the prototype was from Dick Smith Electronics (Cat Z-3982).

The circuit is a blocking oscillator type and the components are not critical – it is almost guaranteed to oscillate. L1 and L2 are wound on an "H" shaped ferrite bobbin which measured 3.25mm inside diameter, 4.25mm inside length. These bobbins are in abundance in switchmode power supplies from old computers, monitors, colour TVs, etc. The precise dimensions are not critical although if the size is too different you may have to alter the value of R1 to compensate.



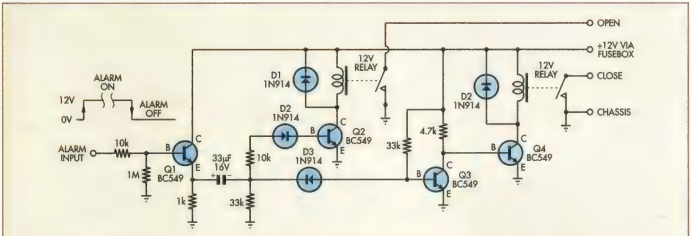
L1 is wound by first stripping the enamel from one end of 0.25mm enamelled copper wire (not critical but physical size needs to be considered) and soldering it to one of the mounting pins of the bobbin. This done, wind 100 turns and strip and solder the other end to the other pin.

L2 is wound straight on top of L1 and consists of 30 turns of the same wire. The ends of this winding are left floating and held in place by hot glue or wax. The reason for such a close turns ratio is to keep the circuit oscillating at very low voltages and very heavy loads.

R1 is 22Ω for a 1.5V battery or 10Ω for a 1.2V battery. For different LEDs or multiple LEDs you may wish to experiment with other values. Instead of risking your expensive white LED you can temporarily use two red LEDs in series. If the LED is out of circuit when the oscillator starts the voltage across C1 (output) quickly rises above 9V. Connecting this to the LED would result in its immediate destruction. Switch off and discharge the capacitor before connecting the LED or make sure the LED is never out of circuit.

L1 measures 300µH. The transistor used is not critical as long as it can handle the input current. The 1.5V circuit draws 130mA for the full 20mA output at 3.6V. If the unit fails to oscillate, as indicated by no or little voltage across C1, reverse either (not both) L1 or L2.

Philip Chugg,
Rocherlea, Tas. ($40)

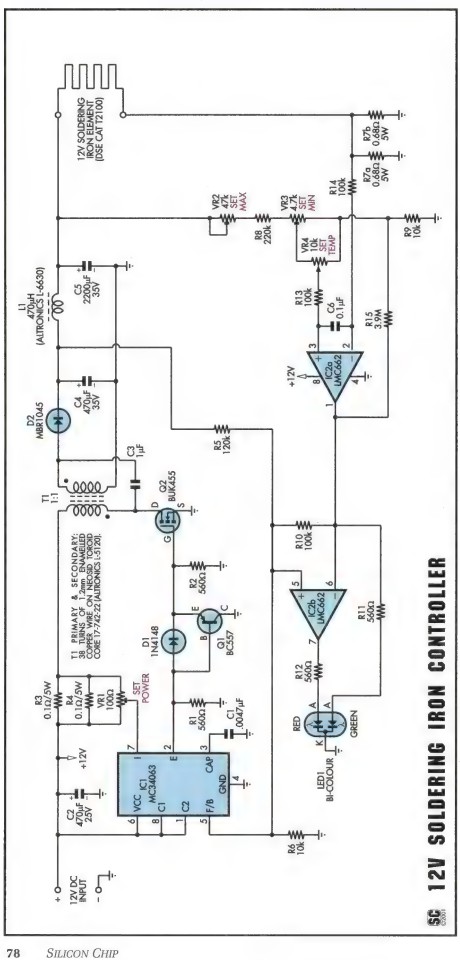


Central locking interface

Some cheap car alarms do not have a connection for the central locking system. However, in most it should be possible to find a point in the alarm circuit which is high when the alarm is activated and low when it is off. This signal can then be used to drive this relay circuit to operate the central locking system.

The interface circuit converts each toggle of the alarm signal to a brief pulse to operate the two relays which then are then connected in parallel with appropriate contacts on the master solenoid in the central locking system.

Frank Keller, via email. ($40)



Temperature-controlled soldering iron

One reason why commercial soldering stations are expensive is that, in general, they require the use of soldering irons with inbuilt temperature sensors, such as thermocouples. This circuit eliminates the need for a special sensor because it senses the temperature of a soldering iron heating element directly from its resistance. Thus this circuit will, in principle, work with any iron with a resistance which varies predictably and in the right direction with temperature (ie, positive temperature coefficient). A soldering iron that's ideally suited for use with this controller is available from Dick Smith Electronics (Cat T-2100).

This circuit runs from a 12V battery or a mains-operated DC source. It works as follows: a DC-DC converter (IC1, Q1, D1, Q2, T1, D2, L1, etc) steps up the 12V DC input to about 16V. The higher voltage boosts the power to the iron and reduces warm-up time. This output voltage is applied to a resistance bridge in which the heating element of the iron forms one leg.

The other components of the bridge include resistors R7-R9 and pots VR2-VR4. When the iron reaches a preset temperature, as set by VR4, the output of IC2a goes high, sending a signal to switching regulator IC1. This forces the output of the converter to a relatively low voltage. A bi-colour LED indicates that the iron has reached the preset temperature by changing from red to green. The iron now begins to cool until it drops below the preset temperature, at which point the output voltage from the DC-DC converter goes high again and the cycle repeats.

A degree of hysteresis built into the circuit makes the LED flicker between red and green while the iron is maintained at its preset temperature.

Calibrate the circuit as follows: while the iron is still relatively cold, monitor the input voltage and current and adjust VR1 so that the input power (Volts x Amps) is about 50W. When you have done that, set VR4 to maximum and adjust VR2 so that the LED flickers between red and green when the iron has reached the desired maximum temperature.

Finally, set VR4 to mid-position and adjust VR3 so that the LED flickers when the iron reaches the desired mid-

range operating temperature. As an example, you might choose to set the maximum temperature to about 400°C and the mid-range operating temperature to about 350°C. The overall temperature range, in that case, should be approximately 280°C to 400°C.

Check that the calibration is correct and repeat the adjustment procedure if necessary. Use a temperature probe, preferably one designed especially for soldering irons, rather than guesswork, when making the adjustment.

Note: VR4 should have a logarithmic taper to compensate for non-linearity in the temperature-resistance characteristic of the soldering iron.

Herman Nacinovich, Gulgong, NSW.

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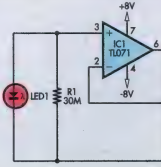
Using a LED as a light sensor

This circuit shows how to use an ordinary LED as a light sensor. It makes use of the photovoltaic voltage developed across the LED when it is exposed to light. LEDs are cheaper than photodiodes and come with a built-in filter, which is useful when the application involves colour discrimination.



The photo-voltage of a red LED (its bandgap voltage) is typically about 2V. The source impedance of this voltage is about 800MΩ in daylight, rising to infinity in darkness. A TL071 JFET input op amp is used to amplify and buffer this extremely high impedance signal.

Resistor R1 ensures that the op amp "sees" a 0V input when the LED is in total darkness. To avoid undue loading of the signal, R1 would ideally be a 100MΩ or larger resistor but since such high values are rare and expensive I used a smaller value and increased the gain of the op amp to compensate for the voltage loss.

To avoid the need for a second variable resistor to set the op amp's input offset to zero, R1 must be large enough for the reduced voltage across the LED to swamp the op amp's input offset voltage. With a 30MΩ resistor for R1, the voltage at the op amp input when the LED is exposed to bright light is reduced to about 60mV. This is just over four times the 13mV maximum input offset of the TL071 op amp.

R1 can be three 10MΩ resistors in series. Alternatively, I have found that a reverse-biased 1N4148 diode has an impedance of about 30MΩ (connect it in the circuit with the anode to ground).

The output of the circuit is about 0V when the LED is in darkness. VR1 sets the gain of the op amp and it should be adjusted to give the required output voltage when the LED is exposed to bright light.

Andrew Partridge, Kuranda, Qld. ($30)

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VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

Test Instruments For Vintage Radio Restoration; Pt.1

The restoration of vintage radios requires a range of skills, from cabinet restoration to fault finding. Fault finding and fine tuning the performance of a piece of equipment is a skill that is developed over time. It is dramatically enhanced by the use of test instruments.

A considerable number of vintage radio buffs don't have a technical background in radio and electronics and may therefore have problems restoring the electronics of their radios.

Run-of-the-mill faults can be found fairly easily found with quite basic instruments. In most cases, if a set hasn't been butchered and is in reasonable condition, it is probable that the set can be restored to working order without the use of instruments. This does not mean plugging the set into the mains or connecting batteries and expecting the set to work properly. Sometimes this is all that is required – but rarely so and I never recommend this approach.

Why is this so? The question has to be asked: "why was the radio taken out of service?" Usually, it was because it had developed some fault.

If the aim is to get the set going without any test instruments, it is often possible to achieve this by replacing components that are known to be particularly troublesome. The key components to be replaced are the automatic gain control (AGC) bypass capacitors, the audio interstage coupling capacitor(s) and the output valve plate bypass capacitor. In addition, the electrolytic filter capacitors in the power supply should be replaced in case they have become short circuit or excessively leaky.

With these components replaced, the set may work and work well but you cannot be sure if all faulty components have been replaced. It's a bit like working blindfolded.

On the other hand, the set may still not work and it could have some serious fault that could cause more damage when power is applied and to anyone who may touch the chassis. Some people are comfortable with this approach but I'm not, although it is less risky that the first method. However, all is not lost, as with the use of a few common test instruments most faults will be found in receivers. This month, we'll start with the humble multimeter.

This photo shows two typical 20,000 ohm/volt moving-coil multimeters. Analog meters have an advantage if the measured reading is fluctuating.

The multimeter

An analog moving coil multimeter or a digital multimeter (DMM) will find most faults where voltage, current or resistance can be measured. It is very helpful to have a circuit when conducting measurements on a piece of radio equipment, or any other electronic gear for that matter. A good circuit diagram will list the voltages

that can be expected at various points throughout a receiver. In older circuits, it will even specify the characteristics of the multimeter, usually 1000 ohms per volt.

Measuring voltages

Until the early 50s, most multimeters had a rating of 1000 ohms per volt. This meant that if the meter was set on the 250V range, it had a total resistance between the two probes of 250,000 ohms (250kΩ), while on the 50V range it had a resistance of 50,000 ohms (50kΩ). It is most important to know this when making measurements.

For example, the first audio stage may have a 250kΩ plate resistor connected to the 250V supply rail – see Fig.1. In order to measure the plate voltage, the multimeter can be switched to the 250V range and the probes connected between the plate of the valve and earth/chassis. However, the maximum reading that can be obtained would be 125V, even if the valve drew no current. This is because of the "loading" effect of the multimeter's internal resistance.

In effect, this internal resistance forms a voltage divider with the 250kΩ resistor connected to the +250V rail, so the reading is much lower than expected – in this case, half the expected reading.

Similarly, if the multimeter was switched to the 50V range, the maximum reading would be 42V. And if the 10V range were selected, the meter would read a maximum of 9.6V. That's because the internal resistance of the meter would be 50kΩ and 10kΩ respectively, and so the loading effects are much greater.

Because of their much higher input impedance, digital multimeters (DMMs) are much more accurate than moving coil types for making voltage measurements. They also often include capacitance measurement, transistor gain and diode check ranges.

However, when reading from the high tension (HT) line to earth, the voltage reading on the meter will be correct as the circuit has virtually no resistance in series with the HT line. To overcome the loading problem it is most desirable that the meter used have a rating of at least 20,000 ohms per volt, which most moving-coil multimeters have. The readings will still be a bit low in high-impedance circuits such as the first audio plate circuit but not drastically so.

Remember that on circuits with voltages shown as measured with a 1000 ohm per volt meter, the actual voltage measured with either a 20,000 ohms per volt meter or a DMM will be higher than the published figures.

A moving-coil multimeter of 20,000 ohms per volt rating cannot measure the AGC voltage in a receiver as it acts as a near short circuit on the AGC line. On the 10V range, it has a resistance of only 200kΩ between the probe points, whereas the AGC filter resistor may be 2MΩ (two megohms). In this case, the indicated AGC voltage reading will be a tenth of normal.

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Having looked at the deficiency of the moving coil multimeter in making measurements in high impedance circuits, it is time to look at ways of overcoming this. A DMM with an input resistance of 10MΩ or more can be used to accurately measure voltages in all but the highest impedance circuits. For normal valve receivers, it can be used to measure all voltages up to around 1000V.

Note that some cheap DMMs, such as the one in the centre of the accompanying photograph, have an input resistance of just 1MΩ which isn't good enough for some circuit measurements in valve receivers. Pay that little bit extra; it's worth it. I use both digital and moving coil multimeters, as each have their strong points.

Measuring current

Measuring current with a DMM or a moving coil multimeter is not a problem with either type. You will need to break into the circuit so that the meter leads can be placed in series with the circuit.

When making measurements, make sure that you start with a high current range and then go lower. Meters do not take kindly to currents or voltages that send the needle or DMM well over range. After you have finished, always make sure that the meter is set back onto a high voltage range (and the meter probes connected to the voltage inputs), otherwise an expensive mistake could be made by connecting a meter that's still on a current range across the power supply.

Unfortunately, I've managed to do this a few times.

Measuring resistance

To accurately measure a resistance, one end of the component to be checked should be lifted out of circuit and then the meter probes placed across the component (usually a coil or a resistor). No adjustment of a DMM is necessary to accomplish this task (other than setting the unit to the "ohms" range) but a moving coil meter should be "zeroed" before trying to measure a resistance.

Moving coil meters have very cramped and rather inaccurate meter readings at the higher resistance readings on each range. By comparison, a DMM is much easier to read.

Always make sure that there are no charged capacitors in circuit when measuring ohms. Not only will the readings be inaccurate but damage to the meter may occur. Return the meter to a high voltage range after measuring resistances so that no meter damage occurs when voltages are next measured.

Selecting a multimeter

(1) Analog multimeters: the AC and DC voltage ranges need to extend to 1000V. The lowest range with full-scale deflection is likely to be 10V for AC and 2.5V for DC. DC current only can be measured with these units and can start from as low as 50μA full scale deflection (FSD) and go to as high as 10A FSD.

The resistance ranges should start at around one ohm per division and measure as low as 1Ω. The maximum resistance that can be measured (or, more accurately, estimated), is in the region of 10-20 megohms. They are quite inaccurate at the high end of the measurement ranges.

The meter movement needs to be rated at 20,000 ohms/volt (or higher).

An analog meter shines particularly when the parameter being measured is varying, as the trend of adjustments can easily be seen. The claimed accuracy of most of these meters is around ±4% FSD.

Examples of units that meet the above criteria are the Altronics Q1025, the Dick Smith Electronics Q1025 and the Jaycar QM-1020. The Altronics and DSE models appear to be identical units. There will be similar units

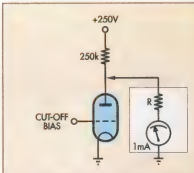

Fig.1: this diagram shows a 1000 ohm per volt meter measuring the plate voltage in a circuit with a 250kΩ plate load resistor. It shows 125V on the 250V range (ie, 50% the correct value), 42V on the 50V range and 9.6V on the 10V range. By contrast, a DMM with an input impedance of 10MΩ gives a reading of 244V – 97.6% the correct value).

Photo Gallery: Music Masters Mozart

Music Masters Radio Company, Brisbane, produced the "Mozart" in 1940. The set is a superhet with the following valves: 6A8-G frequency changer; 6U7-G IF amplifier; 6B6-G first-audio/detector/AVC rectifier; 6V6-G output and 80 rectifier. Photo & information courtesy of the Historical Radio Society of Australia.

from other suppliers too, so have a good look around to find a meter that satisfies your needs.

Digital multimeters

The selection of a suitable DMM is not as simple as selecting an analog meter as there are just so many more to choose from, with a myriad of features.

The first thing I look at is the input resistance and this should be at least 10MΩ or even higher, so that high impedance circuits are not loaded excessively when measurements are being made. Most meters costing more than about $45 are likely to be suitable.

The voltage ranges should start at about 200-400mV AC & DC and extend to 700V AC and 1000V DC. On AC, the maximum frequency that can be applied to the meter without affecting the measurement accuracy varies. A couple of mine will still read the correct voltage at frequencies up to a least 2kHz.

The current ranges should start at around 200μA on AC & DC and extend to 10A or maybe even 20A AC and DC. The resistance ranges should be able to measure to below 1Ω and up to at least 10MΩ or 20MΩ.

One facility I find very handy are capacitance measurement ranges. However, not all meters with such ranges will accurately measure low capacitance values. It is desirable to be able to accurately measure values down to 10pF and up to around 20μF or more. Meters with a range of 4nF (.004μF) or lower will usually measure down to around 10pF with reasonable accuracy.

Always make sure that a capacitor is discharged before trying to measure it, otherwise damage to the meter may occur. With some capacitors, it is necessary to use clip leads to connect them to the meter. If this is done, note the reading of the meter before the capacitor is connected and subtract this from the total reading to compensate for the lead capacitance (note: this only applies when measuring very small value capacitors).

Sometimes, when measuring a capacitor in a receiver, such as a tuning

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Photo Gallery: Stromberg-Carlson Model A22 3-Valve TRF Receiver

Made by Stromberg-Carlson, Sydney, in 1930, the Model A22 is a 3-valve TRF receiver housed in an elegant long-legged wooden cabinet. It was fitted with an 8-inch (200mm) loudspeaker and used the following valves: B443 detector, E415 output and UX280 rectifier. Photo & information courtesy of the Historical Radio Society of Australia.

capacitor, it is desirable to swap the test leads over to get the correct reading. The actual capacity of the meter circuitry may cause erroneous readings if near the receiver chassis.

An audible continuity facility is another useful feature, as this makes it unnecessary to watch the meter when making continuity tests. A diode test range is a handy range too – this will measure the forward voltage drop in a solid state junction, whether it be in a diode or a transistor. It's also handy for checking that there is no conductivity in the reverse direction and for determining whether a transistor is PNP or NPN type and whether a diode is a silicon or germanium type.

An auto-ranging facility is also useful in some circumstances but can be confusing where a range changes unexpectedly. If you believe auto-ranging is for you, make sure that you can manually select the range that you want as well.

Just about a all units these days have a claimed accuracy on the voltage ranges of 0.5% (or better) ±1 count. Of course, this applies only if the meter has not been abused in any way. Accuracy greater than this is not necessary for routine work.

Analog or digital?

This is really your personal choice. Analog units are more suitable if a reading is varying and some people prefer to see a needle moving across a meter scale. That said, digital multimeters (DMMs) are much better value for money, are more accurate and have a greater selection of measurement facilities.

What's more, it doesn't matter which way around you connect the probes when making measurements on a DMM. Analog meters, on the other hand, must be connected with their positive (red) lead to the more positive voltage point when measuring a DC voltage. The same applies when measuring current.

Which ever meter you select, make sure that there is an insulated collar around each probe shaft just above the probe tip. These collars are designed so that if your fingers slip along the probe (eg, in humid weather), they will not come in contact with the metal part of the probe (which could give you a shock).

What do I use? I use both digital and analog meters, although most of the time I prefer a digital meter.

A multimeter, whether it is an analog or digital model, is by far the most important test instrument that you will use for fault-finding and testing vintage radios. Select wisely and you will have a versatile instrument that will last you for years.

However, while a multimeter will allow you to find most faults in a receiver, there are some problems that a multimeter will not be able to detect. Under these circumstances, other test instruments are needed. We'll look at some of these instruments in future columns, including signal generators, signal injectors, signal tracers, transformer testers and so on. **SC**

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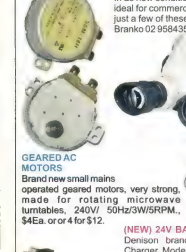

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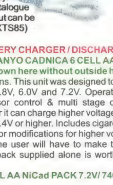

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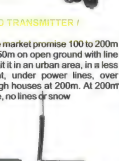

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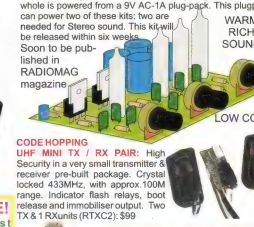
Most transmitters on the market promise 100 to 200m range and deliver only 50m on open ground with line of site. We tested this kit it in an urban area, in a less than ideal environment, under power lines, over metal fences and through houses at 200m. At 200m we had a perfect picture, no lines or snow etc. We are working on a dipole antenna that should give more than 1km range. Easy to build using pre-built Transmitter & Receiver modules. KIT PRICE: (K171)$159

Valve amplifier

A genuine 4 valve amplifier that can drive a pair of headphones. Uses subminiature pentode valves that wire directly to the PCB. Includes Bass, Treble and Volume controls and has transformer and line output connections. The HT volttage is derived by a voltage multiplier and Filament voltage is derived from a voltage regulator. The whole is powered from a 9V AC-1A plug-pack. This plugpack can power two of these kits: two are needed for Stereo sound. This kit will be released within six weeks. Soon to be published in RADIOMAG magazine

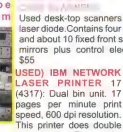
WARM RICH SOUND



LOW COST

CODE HOPPING UHF MINI TX / RX PAIR: High Security in a very small transmitter & receiver pre-built package. Crystal locked 433Mhz, with approx.100M range. Indicator flash relays, boot release and immobiliser output. Two TX & 1 RXunits (RTXC2): $99

HAND HELD BAR-CODE SCANNERS Used SYMBOL brand. These units use a small 1mW helium-neon tube and a scanning motor and columnating optics. Has its own internal 12V power supply to scan bar-codes. Comes with suitable plug-pack and cables.$66

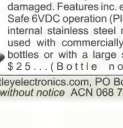


Used desk-top scanners uses a laser diode.Contains four rotating and about 10 fixed front surfaced mirrors plus control electronics $55

USED) IBM NETWORK LASER PRINTER 17 (4317): Dual bin unit. 17 pages per minute print speed, 600 dpi resolution. This printer does double sided printing. These units do not include a toner cartridge or a network card (parallel port only). Weight is 23kg: (ZA0314) $300 (10 only)

20 x 2 LCD BACKLIT CHARACTER DISPLAY: Made by Optrex model #DMC2059, (data is available for similar 20 x 2 displays). 6mm x 8mm characters, 122mm wide x 30mm high. PCB dimensions 151mm wide x 56mm high. Uses standard Hitachi chipset (HD44780) with LED backlight (DLB) $11 each or 3 for $27

(USED) PRO QUALITY CCD CAMERAS: We have a variety of used cameras with a variety of different lenses from $180- check out our website for more info.



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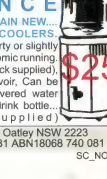

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April 1989: Auxiliary Brake Light Flasher; What You Need to Know About Capacitors; 32-Band Graphic Equaliser; Pt.2.

May 1989: Build A Synthesised Tom-Tom; Bidirectional Monitor For Your PC; Simple Stub Filter For Suppressing TV Interference.

July 1989: Exhaust Gas Monitor; Experimental Mains Hum Sniffers; Compact Ultrasonic Car Alarm; The NSW 86 Class Electrics.

September 1989: 2-Chip Portable AM Stereo Radio Pt.1; High Or Low Fluid Level Detector; Studio Series 20-Band Stereo Equaliser, Pt.2.

October 1989: FM Radio Intercom For Motorbikes Pt.1; GaAsFet Preamplifier For Amateur TV; 2-Chip Portable AM Stereo Radio; Pt.2.

November 1989: Radfax Decoder For Your PC (Displays Fax, RTTY & Morse); FM Radio Intercom For Motorbikes, Pt.2; 2-Chip Portable AM Stereo Radio, Pt.3; Floppy Disk Drive Formats & Options.

January 1990: High Quality Sine/Square Oscillator; Service Tips For Your VCR; Phone Patch For Radio Amateurs; Active Antenna Kit; Designing UHF Transmitter Stages.

February 1990: A 16-Channel Mixing Desk; Build A High Quality Audio Oscillator, Pt.2; The Incredible Hot Canaries; Random Wire Antenna Tuner For 6 Metres; Phone Patch For Radio Amateurs, Pt.2.

March 1990: Delay Unit For Automatic Antennas; Workout Timer For Aerobics Classes; 16-Channel Mixing Desk, Pt.2; Using The UC3906 SLA Battery Charger IC.

April 1990: Dual Tracking ±50V Power Supply; Voice-Operated Switch (VOX) With Delayed Audio; 16-Channel Mixing Desk, Pt.3; Active CW Filter; Servicing Your Microwave Oven.

June 1990: Multi-Sector Home Burglar Alarm; Build A Low-Noise Universal Stereo Preamplifier; Load Protector For Power Supplies.

July 1990: Digital Sine/Square Generator, Pt.1 (covers 0-500KHz); Burglar Alarm Keypad & Combination Lock; Build A Simple Electronic Die; A Low-Cost Dual Power Supply.

August 1990: High Stability UHF Remote Transmitter; Universal Safety Timer For Mains Appliances (9 Minutes); Horace The Electronic Cricket; Digital Sine/Square Generator, Pt.2.

September 1990: A Low-Cost 3-Digit Counter Module; Build A Simple Shortwave Converter For The 2-Metre Band; The Care & Feeding Of Nicad Battery Packs (Getting The Most From Nicad Batteries).

October 1990: The Dangers of PCBs; Low-Cost Siren For Burglar Alarms; Dimming Controls For The Discolight; Surfsound Simulator; OC Offset For DMMs; NE602 Converter Circuits.

November 1990: Connecting Two TV Sets To One VCR; Build An Egg Timer; Low-Cost Model Train Controller; 1.5V To 9V DC Converter; Introduction To Digital Electronics, A 6-Metre Amateur Transmitter.

December 1990: 100W DC-DC Converter For Car Amplifiers; Wiper Pulser For Rear Windows; 4-Digit Combination Lock; 5W Power Amplifier For The 6-Metre Amateur Transmitter; Index To Volume 3.

January 1991: Fast Charger For Nicad Batteries, Pt.1; Hove Fun With The Fruit Machine (Simple Poker Machine); Build A Two-Tone Alarm Module; The Dangers Of Servicing Microwave Ovens.

March 1991: Transistor Beta Tester Mk.2; A Synthesised AM Stereo Tuner, Pt.2; Multi-Purpose I/O Board For PC-Compatibles; Universal Wideband RF Preamplifier For Amateur Radio & TV.

April 1991: Steam Sound Simulator For Model Railroads; Simple 12/ 24V Light Chaser; Synthesised AM Stereo Tuner, Pt.3; A Practical Approach To Amplifier Design, Pt.2.

May 1991: 13.5V 25A Power Supply For Transceivers; Stereo Audio Expander; Fluorescent Light Simulator For Model Railways; How To Install Multiple TV Outlets, Pt.1.

July 1991: Loudspeaker Protector For Stereo Amplifiers; 4-Channel Lighting Desk, Pt.2; How To Install Multiple TV Outlets, Pt.2; Tuning In To Satellite TV, Pt.2.

September 1991: Digital Altimeter For Gliders & Ultralights; Ultrasonic Switch For Mains Appliances; The Basics Of A/D & D/A Conversion; Plotting The Course Of Thunderstorms.

October 1991: Build A Talking Voltmeter For Your PC, Pt.1; SteamSound Simulator For Model Railways Mk.II; Magnetic Field Strength Meter; Digital Altimeter For Gliders, Pt.2; Military Applications Of R/C Aircraft.

November 1991: Colour TV Pattern Generator, Pt.1; A Junkbox 2-Valve Receiver; Flashing Alarm Light For Cars; Digital Altimeter For Gliders, Pt.3; Build A Talking Voltmeter For Your PC, Pt.2.

December 1991: TV Transmitter For VCRs With UHF Modulators; Infrared Light Beam Relay; Colour TV Pattern Generator, Pt.2; Index To Volume 4.

March 1992: TV Transmitter For VHF VCRs; Thermostatic Switch For Car Radiator Fans; Coping With Damaged Computer Directories; Valve Substitution In Vintage Radios.

April 1992: IR Remote Control For Model Railroads; Differential Input Buffer For CROs; Understanding Computer Memory; Aligning Vintage Radio Receivers, Pt.1.

June 1992: Multi-Station Headset Intercom, Pt.1; Video Switcher For Camcorders & VCRs; IR Remote Control For Model Railroads, Pt.3; 15-Watt 12-240V Inverter; A Look At Hard Disk Drives.

August 1992: Automatic SLA Battery Charger; Miniature 1.5V To 9V DC Converter; 1kW Dummy Load Box For Audio Amplifiers; Troubleshooting Vintage Radio Receivers; The MIDI Interface Explained.

October 1992: 2kW 24VDC - 240VAC Sinewave Inverter; Multi-Sector Home Burglar Alarm, Pt.2; Mini Amplifier For Personal Stereos; A Regulated Lead-Acid Battery Charger.

February 1993: Three Projects For Model Railroads; Low Fuel Indicator For Cars; Audio Level/VU Meter (LED Readout); An Electronic Cockroach; 2kW 24VDC To 240VAC Sinewave Inverter, Pt.5.

March 1993: Solar Charger For 12V Batteries; Alarm-Triggered Security Camera; Reardon Trainer; Audio Mixer for Camcorders; A 24-Hour Sidereal Clock For Astronomers.

April 1993: Solar-Powered Electric Fence; Audio Power Meter; Three-Function Home Weather Station; 12VDC To 70VDC Converter; Digital Clock With Battery Back-Up.

June 1993: AM Radio Trainer, Pt.1; Remote Control For The Woofer Stopper; Digital Voltmeter For Cars; Windows-Based Logic Analyser.

July 1993: Single Chip Message Recorder; Light Beam Relay Extender; AM Radio Trainer, Pt.2; Quiz Game Adjudicator; Windows-Based Logic Analyser, Pt.2; Antenna Tuners – Why They Are Useful.

August 1993: Low-Cost Colour Video Fader; 60-LED Brake Light Array; Microprocessor-Based Sidereal Clock; A Look At Satellites & Their Orbits.

September 1993: Automatic Nicad Battery Charger/Discharger; Stereo Preamplifier With IR Remote Control, Pt.1; In-Circuit Transistor Tester; +5V To ±15V DC Converter; Remote-Controlled Cockroach.

October 1993: Courtesy Light Switch-Off Timer For Cars; Wireless Microphone For Musicians; Stereo Preamplifier With IR Remote Control, Pt.2; Electronic Engine Management, Pt.1.

November 1993: High Efficiency Inverter For Fluorescent Tubes; Stereo Preamplifier With IR Remote Control; Pt.3; Siren Sound Generator; Engine Management; Pt.2; Experiments For Games Cards.

December 1993: Remote Controller For Garage Doors; Build A LED Stroboscope; Build A 25W Audio Amplifier Module; A 1-Chip Melody Generator; Engine Management, Pt.3; Index To Volume 6.

January 1994: 3A 40V Variable Power Supply; Solar Panel Switching Regulator; Printer Status Indicator; Mini Drill Speed Controller; Stepper Motor Controller; Active Filter Design; Engine Management, Pt.4.

February 1994: Build A 90-Second Message Recorder; 12-240VAC 200W Inverter; Build A Simple 1.5A 40V Adjustable Power Supply; Engine Management, Pt.5; Airbags In Cars – How They Work.

March 1994: Intelligent IR Remote Controller; 50W (LM3876) Audio Amplifier Module; Level Crossing Detector For Model Railways; Voice Activated Switch For FM Microphones; Engine Management, Pt.6.

April 1994: Sound & Lights For Model Railway Level Crossings; Discrete Dual Supply Voltage Regulator; Universal Stereo Preamplifier; Digital Water Tank Gauge; Engine Management, Pt.7.

May 1994: Fast Charger For Nicad Batteries, Induction Balance Metal Locator; Multi-Channel Infrared Remote Control; Dual Electronic Dice; Simple Servo Driver Circuits; Engine Management, Pt.8.

June 1994: 200W/350W Moslet Amplifier Module; A Coolant Level Alarm For Your Car; 80-Metre AM/CW Transmitter For Amateurs; Converting Phono Inputs To Line Inputs; PC-Based Nicad Battery Monitor; Engine Management, Pt.9.

July 1994: Build A 4-Bay Bow-Tie UHF TV Antenna; PreChamp 2-Transistor Preamplifier; Steam Train Whistle & Diesel Horn Simulator; 6V SLA Battery Charger; Electronic Engine Management, Pt.10.

August 1994: High-Power Dimmer For Incandescent Lights; Microprocessor-Controlled Morse Keyer; Dual Diversity Tuner For FM Microphones, Pt.1; Nicad Zapper (For Resurrecting Nicad Batteries); Electronic Engine Management, Pt.11.

September 1994: Automatic Discharger For Nicad Battery Packs; MiniVox Voice Operated Relay; Image Intensified Night Viewer; AM Radio For Weather Reports; Dual Diversity Tuner For FM Microphones, Pt.2; Electronic Engine Management, Pt.12.

October 1994: How Dolby Surround Sound Works; Dual Rail Variable Power Supply; Build A Talking Headlight Reminder; Electronic Ballast For Fluorescent Lights; Electronic Engine Management, Pt.13.

November 1994: Dry Cell Battery Rejuvenator; Novel Alphanumeric Clock; 80-Metre DSB Amateur Transmitter; Twin-Cell Nicad Discharger (See May 1993); How To Plot Patterns Direct to PC Boards.

December 1994: Easy-To-Build Car Burglar Alarm; Three-Spot Low Distortion Sinewave Oscillator; Clifford – A Pesky Electronic Cricket; Remote Control System for Models, Pt.1; Index to Vol.7.

January 1995: Sun Tracker For Solar Panels; Battery Saver For Torches; Dolby Pro-Logic Surround Sound Decoder, Pt.2; Dual Channel UHF Remote Control; Stereo Microphone Preamplifier.

February 1995: 2 x 50W Stereo Amplifier Module; Digital Effects Unit For Musicians; 6-Channel Thermometer With LCD Readout; Wide Range Electrostatic Loudspeakers, Pt.1; Oil Change Timer For Cars; Remote Control System For Models, Pt.2.

March 1995: 2 x 50W Stereo Amplifier, Pt.1; Subcarrier Decoder For FM Receivers; Wide Range Electrostatic Loudspeakers, Pt.2; IR Illuminator For CCD Cameras; Remote Control System For Models, Pt.3.

April 1995: FM Radio Trainer, Pt.1; Photographic Timer For Darkrooms; Balanced Microphone Preamp; A Line Filter; 50W/Channel Stereo Amplifier, Pt.2; Wide Range Electrostatic Loudspeakers, Pt.3; 8-Channel Decoder For Radio Remote Control.

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August 1995: Fuel Injector Monitor For Cars; Gain Controlled Microphone Preamp; Audio Lab PC-Controlled Test Instrument, Pt.1; How To Identify IDE Hard Disk Drive Parameters.

September 1995: Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.1; Keypad Combination Lock; The Vader Voice; Jacob's Ladder Display; Audio Lab PC-Controlled Test Instrument, Pt.2.

October 1995: 3-Way Bass Reflex Loudspeaker System; Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.2; Fast Charger For Nicad Batteries; Digital Speedometer & Fuel Gauge For Cars, Pt.1.

November 1995: Mixture Display For Fuel Injected Cars; CB Transverter For The 80M Amateur Band; Digital RPM Movement Detector; Digital Speedometer & Fuel Gauge For Cars, Pt.2.

December 1995: Engine Immobiliser; 5-Band Equaliser; CB Transverter For The 80M Amateur Band, Pt.2; Subwoofer Controller; Knock Sensing In Cars; Index To Volume 8.

January 1996: Surround Sound Mixer & Decoder, Pt.1; Magnetic Card Reader; Build An Automatic Sprinkler Controller; IR Remote Control For The Railpower Mk.2; Recharging Nicad Batteries For Long Life.

April 1996: Cheap Battery Refills For Mobile Phones; 125W Audio Amplifier Module; Knock Sensing For Leaded Petrol Engines; Multi-Channel Radio Control Transmitter; Pt.3.

May 1996: Upgrading The CPU In Your PC; High Voltage Insulation Tester; Knightrider Bi-Directional LED Chaser; Simple Duplex Intercom Using Three Optic Cables; Stereo Ray Oscilloscopes, Pt.3.

June 1996: BassBox CAD Loudspeaker Software Reviewed; Stereo Simulator (uses delay chip); Rope Light Chaser; Low Ohms Tester For Your DMM; Automatic 10A Battery Charger.

July 1996: Build A VGA Digital Oscilloscope, Pt.1; Remote Control Extender For VCRs; 2A-5A Battery Charger; 3-Band Parametric Equaliser; Single Channel 8-Bit Data Logger.

August 1996: Introduction to IGBTs; Electronic Starter For Fluorescent Lamps; VGA Oscilloscope, Pt.2; 350W Amplifier Module; Masthead Amplifier For 1.5 & 7.0M Radio Controlled Aeroplanes, Pt.4.

September 1996: VGA Oscilloscope, Pt.3; IR Stereo Headphone Link, Pt.1; High Quality PA Loudspeaker; 3-Band HF Amateur Radio Receiver; Cathode Ray Oscilloscopes, Pt.5.

October 1996: Sand Video Signals Over Twisted Pair Cable; Power Control With A Light Dimmer; 600W DC-DC Converter For Car Hifi Systems, Pt.1; IR Stereo Headphone Link, Pt.2; Build A Multi-Media Sound System, Pt.1; Multi-Channel Radio Control Transmitter, Pt.8.

November 1996: 8-Channel Stereo Mixer, Pt.1; Low-Cost Fluorescent Light Inverter; Repairing Domestic Light Dimmers; Multi-Media Sound System, Pt.2; 600W DC-DC Converter For Car Hifi Systems, Pt.2.

December 1996: Active Filter Cleans Up Your CW Reception; A Fast Clock For Railway Modellers; Laser Pistol & Electronic Target; Build A Sound Level Meter; 8-Channel Stereo Mixer, Pt.2; Index To Volume 9.

January 1997: How To Network Your PC; Control Panel For Multiple Smoke Alarms, Pt.1; Build A Pink Noise Source; Computer Controlled Dual Power Supply, Pt.1; Digi-Temp Monitors Eight Temperatures.

February 1997: PC-Controlled Moving Message Display; Computer Controlled Dual Power Supply, Pt.2; Anti-Theft Zone Loud Sounder Telephone Alarm; Control Panel For Multiple Smoke Alarms, Pt.2.

March 1997: Driving A Computer By Remote Control; Plastic Power PA Amplifier (175W); Signalling & Lighting For Model Railways; Build A Jumbo LED Clock; Cathode Ray Oscilloscopes, Pt.7.

April 1997: Simple Timer With No ICs; Digital Voltmeter For Cars; Loudspeaker Protector For Stereo Amplifiers; Model Train Controller; A Look At Signal Tracing; Pt.1; Cathode Ray Oscilloscopes, Pt.8.

May 1997: Neon Tube Modulator For Light Systems; Traffic Lights For A Model Intersection; The Spacevrtex — It Writes Messages In Thin Air; A Look At Signal Tracing; Pt.2; Cathode Ray Oscilloscopes, Pt.9.

June 1997: PC-Controlled Thermometer/Thermostat; TV Pattern Generator, Pt.1; Audio/RF Signal Tracer; High-Current Speed Controller For 12V/24V Motors; Manual Control For Stepper Motors.

July 1997: Infrared Remote Volume Control; A Flexible Interface Card For PCs; Points Controller For Model Railways; Colour TV Pattern Generator, Pt.2; An In-Line Mixer For Radio Control Receivers.

August 1997: The Bass Barrel Subwoofer; 500 Watt Audio Power Amplifier Module; A TENs Unit For Pain Relief; Addressable PC Card For Stepper Motor Control; Remote Controlled Gates For Your Home.

September 1997: Multi-Spark Capacitor Discharge Ignition; 500W Audio Power Amplifier, Pt.2; A Video Security System For Your Home; PC Card For Controlling Two Stepper Motors; HiFi On A Budget.

October 1997: Build A 5-Digit Tachometer; Add Central Locking To Your Car; PC-Controlled 6-Channel Voltmeter; 500W Audio Power Amplifier, Pt.3; Customising The Windows 95 Start Menu.

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December 1997: A Speed Alarm For Your Car; Two-Axis Robot With Gripper; Loudness Control For Car Hifi Systems; Stepper Motor Driver With Onboard Buffer; Power Supply For Stepper Motor Cards; Understanding Electric Lighting Pt.2; Index To Volume 10.

January 1998: Build Your Own 4-Channel Lightshow, Pt.1 (runs off 12VDC or 12VAC); Command Control System For Model Railways, Pt.1; Pan Controller For CCD Cameras; Build A One Or Two-Lamp Flasher; Understanding Electric Lighting, Pt.3.

February 1998: Multi-Purpose Fast Battery Charger, Pt.1; Telephone Exchange Simulator For Testing Phones; Command System For Model Railways, Pt.2; Build Your Own 4-Channel Lightshow, Pt.2.

April 1998: Automatic Garage Door Opener, Pt.1; 40V 8A Adjustable Power Supply, Pt.1; PC-Controlled 0-30kHz Sinewave Generator; Build A Laser Light Show; Understanding Electric Lighting, Pt.6.

May 1998: Troubleshooting Your PC, Pt.1; Build A 3-LED Logic Probe; Automatic Garage Door Opener, Pt.2; Command Control For Model Railways, Pt.4; 40V 8A Adjustable Power Supply, Pt.2.

June 1998: Troubleshooting Your PC, Pt.2; Understanding Electric Lighting, Pt.7; Baseband High Density Digital Recording System; The Readies' Friend Cable Tester; Universal Stepper Motor Controller; Command Control For Model Railways, Pt.5.

July 1998: Troubleshooting Your PC, Pt.3 (Installing A Modem And Solving Problems); Build A Heat Controller; 15-Watt Class-A Audio Amplifier Module; Simple Charger For 6V & 12V SLA Batteries; Automatic Semiconductor Analyser; Understanding Electric Lighting, Pt.8.

August 1998: Troubleshooting Your PC, Pt.4 (Adding Extra Memory); Build The Opus One Loudspeaker System; Simple I/O Card With Automatic Data Logging; Build A Beat Triggered Strobe; A 15-Watt Per Channel Class-A Stereo Amplifier.

September 1998: Troubleshooting Your PC, Pt.5 (Software Problems & DOS Games); A Blocked Air-Filter Alarm; A Wax-Wea Pedal For Your Guitar; Build A Plasma Display On Jacob's Ladder; Gear Change Indicator For Cars; Capacitor Discharge Ignition Modifications.

October 1998: Lab Quality AC Millivoltmeter, Pt.1; PC-Controlled Stress-O-Meter; Versatile Electronic Guitar Limiter; 12V Trickle Charger For Float Conditions; Adding An External Battery Pack To Your Flashgun.

November 1998: The Christmas Star; A Turbo Timer For Cars; Build A Time Machine, Pt.1; FM Transmitter/Receiver For Hi-Fi; Lab Quality AC Millivoltmeter, Pt.2; Setting Up A LAN Using TCP/IP; Understanding Electric Lighting, Pt.9; Improving AM Radio Reception, Pt.1.

December 1998: Protect Your Car With The Engine Immobiliser Mk.2; Thermocouple Adaptor For DMMs; A Parallel 12V DC Plugpack; Build Your Own Poker Machine, Pt.2; Improving AM Radio Reception, Pt.2; Mixer Module For F3B Power Operations.

January 1999: High-Voltage Megohm Tester; Getting Started With BASIC Stamp; LED Bargraph Ammeter For Cars; Keypad Engine Immobiliser; Improving AM Radio Reception, Pt.3.

March 1999: Getting Started With Linux, Pt.1; Build A Digital Thermometer; 3-Channel Current Logger With Data Logging; Simple DIY PIC Programmer; Easy-To-Build Audio Compressor; Low Distortion Audio Signal Generator, Pt.2; Electric Lighting, Pt.12.

April 1999: Getting Started With Linux, Pt.2; High-Power Electric Fence Controller; Bass Cube Speaker System; Programmable Thermostat Thermometer; Build An Infrared Sentry; Rev Limiter For Cars.

May 1999: The Line Dancer Robot; An X-Y Table With Stepper Motor Control, Pt.1; Three Electric Fence Testers; Heart Of LEDs, Build A Cartoon Animation Display; Programmable Ignition Timing, Pt.3.

June 1999: FM Radio Tuner Card For PCs; X-Y Table With Stepper Motor Control, Pt.2; Programmable Ignition Timing Module For Cars, Pt.1; Hard Disk Drive Upgrades Without Reinstalling Software?

July 1999: Build A Dog Silencer; 10µH to 19.99mH Inductance Meter; Build An Audio-Video Transmitter; Programmable Ignition Timing Module For Cars, Pt.2; XYZ Table With Stepper Motor Control, Pt.3.

August 1999: Remote Modem Controller; Daytime Running Lights For Cars; Build A PC Monitor Checker; Switching Temperature Controller; XYZ Table With Stepper Motor Control, Pt.4; Electric Lighting, Pt.14.

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October 1999: Build The Railpower Model Train Controller, Pt.1; Semiconductor Curve Tracer; Autonomouse The Robot, Pt.2; XYZ Table With Stepper Motor Control, Pt.6; Introducing Home Theatre.

November 1999: Electric Lighting, Pt.15; Setting Up An Email Server; Speed Alarm For Cars, Pt.1; Multi-Colour LED Christmas Tree; Build An Intercom Station Expander; Foldback Loudspeaker System For Musicians; Railpower Model Train Controller, Pt.2.

December 1999: Electric Lighting, Pt.16; Build A Solar Panel Regulator; The PC Powerhouse (gives fixed +12V, +9V, -9V & +5V rails); The Fortune Finder Metal Locator; Speed Alarm For Cars, Pt.2; Railpower Model Train Controller, Pt.3; Index To Volume 12.

January 2000: Spring Reverberation Module; An Audio-Video Test Generator; Build The Picman Programmable Robot; A Parallel Port Interface Card; Off-Hook Indicator For Telephone Lines.

February 2000: Multi-Sector Sprinkler Controller; A Digital Voltmeter For Your Car; An Ultrasonic Parking Radar; Build A Safety Switch Checker; Build A Sine/Square Wave Oscillator; Marantz SR-18 Home Theatre Receiver (Review); The "Hot Chip" Starter Kit (Review).

March 2000: Resurrecting An Old Computer; Low Distortion 100W Amplifier Module, Pt.1; Electronic Wind Vane With 16-LED Display; Slowplug Driver For Powered Models; The OzTrip Car Computer, Pt.1.

May 2000: Ultra-LD Stereo Amplifier, Pt.2; Build A LED Dice (With PIC Microcontroller); Low-Cost AT Keyboard Translator (Converts IBM Scan-Codes To ASCII); 50A Motor Speed Controller For Models.

June 2000: Automatic Rain Gauge With Digital Readout; Parallel Port VHF FM Receiver; L/I Powerhouse Switchmode Power Supply (1.23V to 40V) Pt.1; CD Compressor For Cars Or The Home.

July 2000: A Moving Message Display; Compact Fluorescent Lamp Driver; El-Cheapo Musicians' Lead Tester; L/I Powerhouse Switchmode Power Supply (1.23V to 40V) Pt.2; Say Bye-Bye To Your 12V Car Battery.

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January 2001: LP Resurrection – Transferring LPs & Tapes To CD; The LP Doctor – Clean Up Clicks & Pops, Pt.1; Arbitrary Waveform Generator; 2-Channel Guitar Preamplifier, Pt.3; PIC Programmer & Tester; Wireless Intercoms.

February 2001: How To Observe Meteors Using Junked Gear; An Easy Way To Make PC Boards; L'il Pulser Train Controller; Mid-Mate – A MIDI Interface For PCs; Build The Bass Blaster; 2-Metre Elevated Groundplane Antenna; The LP Doctor – Clean Up Clicks & Pops, Pt.2.

March 2001: Driving Your Phone From A PC; Making Photo Resist PC Boards At Home; Big-Digit 12/24 Hour Clock; Parallel Port PIC Programmer & Software; Speed Alarm Sound; Protoboards – The Easy Way Into Electronics, Pt.5; More MIDI – A Simple MIDI Expansion Box.

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May 2001: Powerful 12V Mini Stereo Amplifier; Microcontroller-Based 4-Digit Counter Modules; Two White-LED Torches To Build; A Servo With Lots Of Grunt; Parallel Port Powerful Multi-Voltage Power Supply; Using Linux To Share An Internet Connection, Pt.1; Computer Tips – Tweaking Windows With Tweakui.

June 2001: Fast Universal Battery Charger, Pt.1; Phonome – Call, Listen In & Switch Devices On & Off; L'il Snooper – A Low-Cost Automatic Camera Switcher; Using Linux To Share An Internet Connection, Pt.2; A PC To Die For, Pt.1; Building Your Own PC).

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PLEASE NOTE: November 1987 to March 1989, June 1989, August 1989, December 1989, May 1990, February 1991, June 1991, August 1991, January 1992, February 1992, July 1992, September 1992, November 1992, December 1992, January 1993, May 1993, February 1996, March 1998 and february 1999 are now sold out. All other issues are presently in stock. For readers wanting articles from sold-out issues, we can supply photostat copies (or tear sheets) at $7.70 per article (includes p&p). When supplying photostat articles or back copies, we automatically supply any relevant notes & errata at no extra charge. A complete index to all articles published to date is available on floppy disk for $11 including p&p, or can be downloaded free from our web site: www.siliconchip.com.au

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Fence tester does not flash

I was wondering if there was a modification to the Maxi Electric Fence Tester described in the May 1999 issue. I purchased it to monitor the performance of a mini electric fence module. We are failing to keep the cats off a balcony and have been losing fish.

The electric fence tester is not flashing. I can measure 500V+ from the anode to the cathode, which I suspect should just about fire the tube without any triggering pulses. I don't have a means of measuring a trigger pulse. The 220kΩ resistor reads correctly. Any suggestions or advice would be appreciated. (J. G., via email).

● It seems possible that the electric fence tester is not delivering a suitable pulse to fire the Xenon tube even though it has enough voltage across it to fire. Try connecting the tester with the opposite polarity; ie, connect the HT end to the ground stake and the ground end to the HT of the fence. This will reverse the trigger pulse polarity and may be all that is needed to fire the Xenon tube. It will not reverse the voltage across the Xenon tube as this is rectified using diodes D1-D4.

If this does not work, try connecting the 220kΩ resistor to a point further up the 820Ω resistor string; ie, connect it a few resistors further toward the fence high-tension end of the string. This should give more trigger voltage to the Xenon tube. Again, try both fence connection polarities.

Thermostat not needed for Turbo Timer

I've have just recently bought the Turbo Timer kit (described in November 1998) from Jaycar Electronics. While putting it together, I decided that I would not use the thermostat as it is too much trouble to install it. So what needs to be altered in order to bypass the thermostat in order for the Turbo Timer to always be activated when the car keys are taken out? Is there even a need to alter the thermostat? (L. T., via email).

● If you do not wish to use the thermostat, then simply leave this connection open-circuit. In other words, do not make a connection to the thermostat terminal on the PC board.

Query on transformer VA ratings

In the 1978 edition of the ARRL handbook it says that for both a full-wave bridge (four diode) and a two-diode centre-tapped full-wave rectifier, the diodes can to be rated at half the DC current being drawn by the load. It also says that for a full-wave bridge, the transformer VA needs to be calculated based on the DC current being drawn but for a two-diode centre-tapped arrangement, the VA needs to be calculated based on 0.7 (ie, root 2) of the DC current. For a non-filtered load is this correct? It would mean that the centre-tapped transformer would have to be 1.4 times the VA of one that used a bridge diode setup.

● In practice, you would take a much more conservative approach in the ratings of the diodes, allowing for transient voltages and initial surge currents. Either way, the VA rating on the transformer would be the same since the total power supplied would be the same.

Charger for AAA cells wanted

I have a Kodak MC3 digital camera and MP3 player and it uses three AAA batteries. Buying new disposable batteries all the time is impractical and expensive. I need a charger that can fast-charge two sets of three AAA batteries at a time. Could you suggest a kit or a product I could buy? (A. T., Wagga Wagga, NSW).

● Our Fast Universal Charger published in the June & July 2001 issues will charge 3.6V Nicads or NiMH batteries (ie, it can do 3 AAA nicads in series) but it could not do two sets at one time because it could not properly monitor the "end-point" voltage of both sets.

Computer video signals are different to PAL

I'd like some advice on combining the y/c signals from a computer video card so that the signal can be recorded on a VCR with composite video input terminals.

Can this be done as simply as audio signals can be combined with a vir-

Charging smaller Nicads

I have a query about the Multi-purpose Fast Battery Charger as described in your June 2001 issue. The charge and discharge rates for Nicads seem more suited to larger capacity cells. I use a lot of AA Nicads, most of which are 500mA.h. Is it possible to provide lower charge and discharge rates for these smaller cells? (J. B., via email).

● The design is not easily changed to provide lower charging and discharging rates. These changes would be best done by redesigning the project with smaller and cheaper mains and switching transformers.

However, without changing the design too much, the charge and discharge currents can be effectively halved by using only one instead of two 0.1Ω 5W resistors for current sensing. This will mean that the setting for 1.2Ah cells will now be 600mA.h.

Switching could be incorporated to select a charge current of 6A or 3A. Keep the leads to the switch short. The best position for the switch would be directly on the PC board, adjacent to the 0.1Ω resistor.

tual earth mixer or is it more complex than that? (S. B., via email).

● It is not possible to record the video signals for a computer monitor on a VCR because the video standards are quite different. The horizontal and vertical sweep frequencies are faster than for PAL or NTSC and there is no colour burst signal. While there are VGA to PAL adaptors, they are quite complex.

Coil for ignition system

What sort of coil do you have to use with the High Energy Ignition kit? Do you use a coil that needs a ballast resistor or one without, eg, Bosch GT40R? (M. K., via email).

● Definitely do not use a high-current coil like the Bosch GT40/r series. Use the standard coil intended for your car. Failing that, use a 12V coil.

Setting up a CCTV system

I have been wondering for some time now how I may be able to install a home closed circuit video security system that is simple and avoids the high expense associated with the professionally installed systems. I do not want the computer-based models as the computer is often the first item stolen or damaged and besides, I do not want one running perpetually while I am away. A 12V supply for cameras etc I can handle.

All of the equipment I have seen/read about to date requires a time-lapse video recorder. These are expensive and no doubt have been developed for shopping centres and banks.

I can buy three or four normal VCRs for the price of a time-lapse model and all I need it to do is to switch it on in record mode. I want this mode so that I can operate the VCR from a PIR detector when the house is unoccupied. PIR on, the VCR records, PIR off, the VCR stops – simple?

My enquiries to service people would seem as if I was asking for a trip to the moon! Surely someone can develop a circuit/device that would allow a home VCR to be so modified, even if the VCR has to be taken to a technician to have the work done. What do you think? (G. E., via email).

● We have done exactly that project (camera, PIR, VCR etc) in the September 1997 issue.

Tacho display too bright

I recently made the Digital Tacho from the August 1991 issue. Everything went well and it worked as it should. In the daytime you can see the numbers well but at night-time, boy are the numbers bright; they are so bright that I have to pull the plug on it. Is there a way to dim the numbers to a readable brightness, which would not require a great deal of change to the circuit, using an LDR or something like that? (D. C., via email).

● The only way to reduce the brightness of the displays would be to reduce the 9V rail by replacing the 150Ω resistor in the GND pin of the 7805 with a 200Ω wirewound pot. These are available from DSE, Cat R-6911. However, if you reduce the supply much below 6V it is likely that the circuit itself may malfunction.

Fuel mixture display shows lean

I bought the Jaycar fuel mixture display kit and hooked it to my 1994 Holden Barina GSi but the only LEDs that come on are the red ones. When I start the engine the last LED comes on but as I turn the trimpot fully to the left, only the second last LED lights.

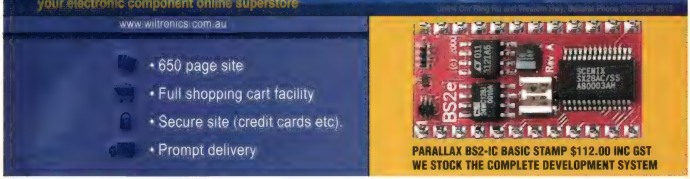
As the car warms up, the last LED comes on and it stays that way. Is the Barina designed differently and do I need to replace the resistor with ones with different values. There are no solder bridges and all the LEDs are correctly positioned. What can I do? (G. E., via email).

● We are not sure what you mean by "only the red LEDs come on" as all the LEDs are red. We assume you mean that the display always shows lean mixture with the lower two LEDs lighting. Possibly the problem is with the adjustments of both VR2 and VR3. You need to set them as described in the adjustment section of the article.

Also check that the connection to the EGO has a good ground. Differences between the ground connection for the power supply on the fuel mixture display unit and the sensor ground can cause the display to show lean.

Hall Effect sensor for ignition system

Could you please advise me if I can use the UGN3503u Hall Effect sensor instead of the HKZ101 Hall sensor with: (1) a distributor ring magnet assembly, similar to the Sparkrite ring



Li'L Pulser Train Controller is full on

My son and I have enjoyed putting the kit for the Li'L Pulser Train Controller together but there are a couple of problems we have been unable to resolve.

First, the speed adjustment doesn't work; ie, the train either goes forward at full speed or back at full speed.

The Track LED (#3) shows green when switched to reverse and red when switched to forward, and its intensity doesn't vary with the position of the potentiometer (VR1). It does not appear that the LED was fitted the wrong way round, as the flattened (K) side of the light base is in the correct orientation (the ends, of course, have been trimmed). It is possible that these problems are related.

I have been through the suggested checks: the voltages across the ICs are correct but I have not adjusted the trimpots yet. The shorting siren works and potentiometer (VR1) seems to work.

I am assuming that there is a problem with the delivery of the sawtooth signal to IC2 but really I have no idea where the problem lies. (J. W., Nedlands, WA).

● The circuit appears to have a problem driving the Mosfet with a switchmode signal. This could be due to any number of causes including: the pin 7 output of IC2a is tied to pin 8 via a solder bridge; the 6.8kΩ resistor at VR1 is either the wrong value or it is not connecting to ground; IC1b is not producing a triangle waveform which should show about 6V at pin 1 when measuring DC volts; or error amplifier IC1a has pin 7 set low because of incorrect setting of VR2.

The colour of the LED is not important. Some bi-colour LEDs have the anode terminal for a red LED while other LEDs may have the anode for a green LED. To change the colour for forward or reverse simply swap the leads.

magnet sold by Jaycar some years ago; (2) a crankshaft-mounted notched trigger wheel or (3) a crankshaft-mounted trigger wheel with magnets? (K. W., via email).

● You can use a magnet assembly to drive the UGN3503 Hall effect unit. It comprises a Hall effect unit biased to produce a 2.5V output with a 5V supply. The voltage swings above or below 2.5V, depending on the polarity of the magnet.

You will need to capacitively couple the Hall effect output to the reluctor input circuit of the High Energy Ignition. Use a large bipolar electrolytic such as a 47μF for coupling. Also note that the UGN3503 needs a 5V supply (see the Dick Smith Electronics catalog data section). A 5.1V zener can be used in conjunction with the 12V supply and a 330Ω series resistor to provide this. Decouple the 5.1V supply with a 100μF electrolytic capacitor.

A toothed crankshaft wheel will work if it has magnets attached.

Keyboard amplifier wanted

I propose to use your 100W class AB amplifier – ie, the one using the Motorola plastic power devices – as a keyboard performance amplifier. I'd prefer to dispense with the regulated rails and just use one unregulated plus & minus supply for the sake of simplicity. Obviously, in this application, I'm prepared to sacrifice a degree of fidelity. Would you mind giving me your opinion on whether this would be OK? (B. V., via email).

● Yes, you can do that but you are wasting the design. You would be better off building the much cheaper (and more powerful) Plastic Power amplifier module described in the April 1996 issue.

New remote control for alarm

I have a Repeller alarm in my car. Is it possible to get another remote (preferably smaller) for it? (A. S., via email).

● There are couple of problems here. You cannot just replace the remote handpiece because the new transmitter must have exactly the same coding as the original. Unless the substitute transmitter uses the same encoder chip as the original, then the chances of matching codes are zero.

Another approach is that you may be able to replace the transmitter and the receiver/decoder in the alarm itself. If this is possible, you could look at one of the remote controls featured in our February 1996 issue.

Alternatively, you could purchase a learning UHF remote such as the Cat LA-8990 from Jaycar Electronics.

Using 4-ohm loads with the class-A amplifier

I have built the class-A amplifier from the July & August 1998 issues and am pleased with its performance. The specs state that it is rated at 15W into 8Ω. Can you tell me what it is likely to achieve into 4Ω? Also, is it possible to increase the output by par-

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CD burners with 200 MMX Pentiums

I loved the September issue, especially the article that allows me to turn my old computer into an MP3 music machine.

Unfortunately, I am stuck with a 200MHz MMX Pentium VX motherboard for the present. I recently upgraded to a 40GB Seagate 7200 RPM hard-drive (only 8GB is formattable), with Windows 98SE as my operating system. This allows me to do many things but best of all I can connect USB items.

I want to connect a CD burner but get conflicting information from salesmen. None of the burnproof units seem to be compatible with a 200MMX Pentium. Can you tell me why these units will not work with my system? (M. T., Donvale, Vic).

- Manufacturers seem to allow quite a big performance margin in their spec list. There is every chance that these drives will indeed run on your machine.

Our guess is that you'll need at least 48MB of memory and you may not be able to run other applications while burning CDs (this can be risky even on fast machines!).

The specs are pushed up somewhat in order to include support for on-the-fly CD audio track ripping and encoding. Even if your machine isn't fast enough to do this on-the-fly, it's not a major problem; just save to hard disk first in .WAV format and then convert to MP3.

It will be necessary to upgrade the motherboard BIOS to format all 40GB of your new hard disk drive. Alternatively, you can use Seagate's Disk Manager utility. You'll find it at: **www.seagate.com/support/disc/drivers/discwiz.html**

alleling the output transistors and the power supply? (S. F., Lake District, UK).

- You can operate the class-A amplifier with 4-ohm loads and it will probably deliver about 25 to 30 watts maximum. The only problem is that once the load current exceeds about 1.9A peak, the amplifier will no longer be in class A. Instead, it will be in class AB (albeit with exceedingly low crossover distortion artefacts) for power levels above 7.5 watts.

While we have not looked closely at the biasing, if you wanted to run in class-A up to full power for 4-ohm loads, you would need to double the quiescent current. You would not need to double up on the output transistors but you would need a fan-cooled heatsink to cope with the 80W dissipation and you would need a bigger power supply.

Boosting the remote control extender

Is it possible to run more than one IRLED on the remote control extender (July 1996)? If so, what do I have to do so it still works because I have two units in different places? (R. S., via email).

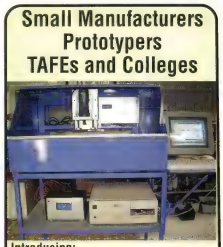
- You can run another IRLED via a separate 220Ω resistor connected to transistor Q1.

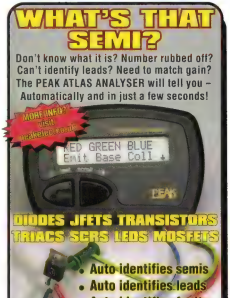
Notes & Errata

Multi-Purpose Fast Battery Charger II, June & July 2001: this charger is not suitable for charging cells and batteries with capacities below 1.2AH and voltages below 6V. AA and AAA Nicad and NiMH cells should not be connected to this charger as the "No Batt" LED will light due to the cell voltage rising above 2V with initial charging. However, the charger will charge a 6V AA Nicad battery pack successfully.

LED Number Display, September 2001: the circuit on page 69 shows the 4511 7-segment decoder pins correctly but the labels for LE (latch enable) and LT (lamp test) have been swapped.

Synchronous Clock Driver, October 2001: the circuit on page 37 has a number of errors. IC1 should have the positive rail to pin 14 and 0V to pin 4, while pins 4 & 6 have been transposed. On IC4, pins 3 & 11 have been transposed. In the text, the last line of the second last paragraph should read "with the clock signal to IC4". The second line of the last paragraph should read "pins 4 & 10 of IC1. And the reference to R1 should be R2, in the last paragraph. **SC**





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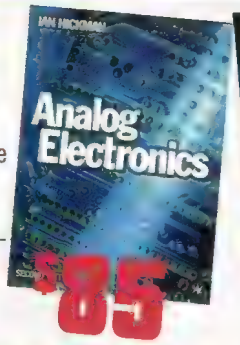

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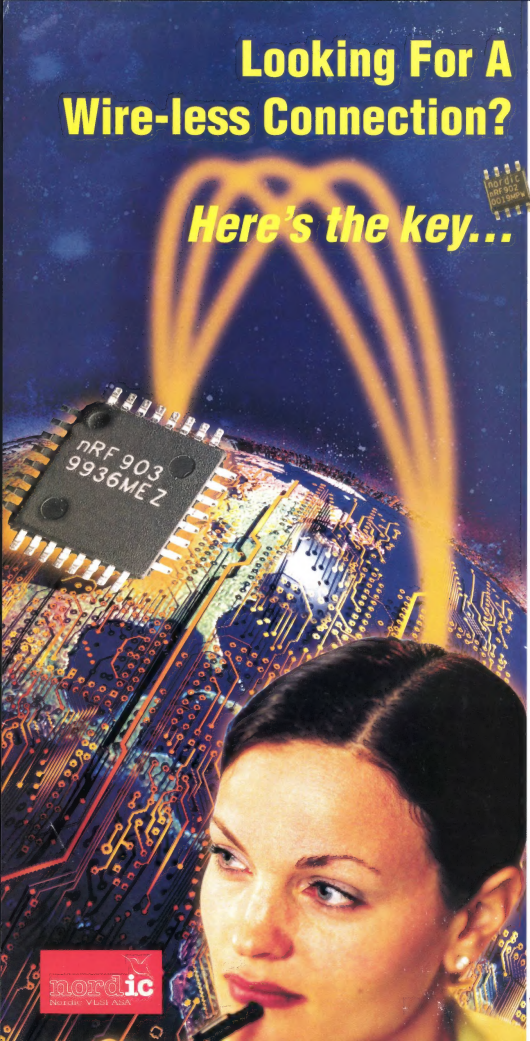

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